

SR 92 Widening and Reconstruction from the Northpoint Parkway to the Cherokee Trail

Cherokee County, Georgia

Value Engineering Study Report

Final Design Development

May 2004

Design Consultants

Georgia Department to Transportation (Project 40)

and

URS (Project 42)

Value Engineering Consultant



Lewis & Zimmerman Associates, Inc.



Lewis & Zimmerman Associates, Inc.

Taking the Chance out of Change

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May 7, 2004

Ms. Lisa L. Myers
Design Review Engineer Manager
State of Georgia Department of Transportation
General Office
No. 2 Capitol Square, Room 266
Atlanta, Georgia 30334-1002

re: Project Numbers NH-165-1 (40), Widening of State Route 92 from Woodland Road to Cherokee Trail and NH-165-1 (42), State Route 92 Widening from Northpoint Parkway to Woodland Drive in Cherokee County, Georgia
Value Engineering Study Report

Dear Ms. Myers:

Lewis & Zimmerman Associates, Inc. is pleased to submit four hard copies and one electronic copy of the referenced report.

The alternatives addressed during this VE effort identify opportunities to improve the value of the project in terms of potential capital cost reductions, assured increased capacity, reduction in overall congestion, upgrading of the corridor, soundness of solutions, improved constructibility, and improved level of service.

We take this opportunity to thank you and the State of Georgia Department of Transportation participants for your efforts to assist the VE team in generating new, creative solutions for this project. We look forward to working with you on future assignments and are available to answer any questions you may have as you review these alternatives and determine implementation.

Sincerely,

LEWIS & ZIMMERMAN ASSOCIATES, INC.

Luis M. Venegas, PE, CVS-Life

Vice President

Attachment

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EXECUTIVE SUMMARY

INTRODUCTION

This Value Engineering (VE) Study Report summarizes the events of the VE study conducted by Lewis & Zimmerman Associates, Inc. (LZA) for the State of Georgia Department of Transportation (GDOT), Atlanta, Georgia. The subject of the study was the SR 92 Widening and Reconstruction from the NH-165-1 (40), Widening of State Route 92 from Woodland Road to Cherokee Trail and NH-165-1 (42), State Route 92 Widening from Northpoint Parkway to Woodland Drive in Cherokee County, Georgia. The projects are located in Cherokee County, Georgia. Project 40 is being designed by GDOT and Project 42 is being designed by URS of Atlanta, Georgia.

The workshop was conducted April 12 – 14, 2004 in GDOT's offices in Atlanta.

PROJECT DESCRIPTION

Project 40 consists of the widening and reconstruction of a 4.773 kilometer section of SR 92 from its current two-lane configuration into a four-lane roadway with two lanes in each direction separated by a 44-foot depressed grassed median and three lanes with a 20-foot raised median in the developed area in the vicinity of Bells Ferry Road

Project 42 consists of the widening and reconstruction of a 6.838 kilometer section of SR 92 from its current two-lane configuration into a four-lane roadway with two lanes in each direction separated by a 44-foot depressed grassed median and includes the construction of new twin bridges over Clark Creek.

The current probable cost of construction for both projects has been estimated at \$95,403,975. This figure is composed of \$24,872,080 for Project 40 and \$70,531,895 for Project 42 that was derived from revised programmed costs dated December 31, 2003, and January 7, 2004, respectively. The aforementioned costs include \$12,550,000 and \$47,748,000 worth of right-of-way (ROW) purchases for Projects 40 and 42, respectively. Both projects contain engineering and construction contingencies of 10.00%. Project 40 has an inflation rate of 10.25% (based on 5.00% per annum for two years) while Project 42 has an inflation rate 34.01% (based on 5.00% per annum for six years).

CONCERNS AND OBJECTIVES

No major concerns were indicated by GDOT beyond the normal improvements expected with any good value engineering effort. Both projects are being designed to alleviate congestion, increase capacity, and improve safety along this portion of SR 92 in Cherokee County which contains actively growing and expanding communities within the county. However, Project 40, the eastern end of this portion of the SR 92 corridor widening, is scheduled to be let in the year 2005. As such, the immediacy of the letting reduces the opportunity to effect holistic change along these 4.8 kilometers of the widening. Nevertheless, improvements were to be sought in furthering safety and overall cost reductions.

On the other hand, Project 42, the western end of the widening along this portion of the SR 92 corridor, had greater chances for improvement in terms of alignment/realignment, reduction in median width, and wetland spanning opportunities without jeopardizing the project's need and purpose.

One concern noted by the VE team was the apparent overstated right-of-way costs associated with Project 42 at \$47,748,000. This approaches \$7,000,000 per kilometer in the least congested portion of the corridor. When compared to the ROW costs of Project 40 at \$12,550,000 where most of the congestion is currently encountered, the cost per kilometer is about \$2,600,000. This situation warrants further investigation by GDOT as the VE team did not have the necessary resources to effect logical real estate and relocation costs.

Therefore, in order to accomplish the project's goals in an expeditious and cost effective manner, and assist in ameliorating the concerns noted, GDOT conducted this VE study. The objective of the effort was to identify opportunities that would improve the value of the project in terms of potential capital cost reductions, improvement of safety, reduction of congestion, soundness of solutions, improved constructibility, and improved level of service.

HIGHLIGHTS OF THE STUDY

These projects are relatively straightforward concepts to widen and reconstruct two, interconnected portions of the SR 92 corridor in Cherokee County. Listed below are some of the more salient ideas resulting from the brainstorming session. They are provided here as a sampling of the contents of the report.

Bridge for Project 42 (B-X (42))

Numerous alternatives were developed associated with the only bridge structure on the project, a twin two-lane facility spanning Clark Creek. The single most cost-effective change is noted on Alternative B-1 (42) that spans Clark Creek with a 70 meter bridge in lieu of the proposed twin 347.7 meter bridges with embankment approaches creating a "causeway" type facility in the wetlands. Initial cost savings exceeding \$2,000,000 are noted. In a similar manner, Alternative B-6 (42) would use a causeway type construction while spanning Clark Creek with a triple-cell box culvert similar to the existing Clark Creek crossing that is to be abandoned. Savings for this configuration approach \$800,000.

A combination of bridge and alignment changes noted on Alternative B-2 (42) would retain the existing SR 92 alignment at the west end of the project starting at the existing culvert spanning Clark Creek and then swinging northeasterly to tie into the proposed new alignment at approximately Old Alabama Road. This new condition would require the construction of one new creek crossing parallel to the existing culvert to accommodate the eastbound traffic while westbound traffic would use the existing alignment. A second creek spanning structure is eliminated although it acknowledges additional environmental impacts on the wetlands around Clark Creek. Regardless, initial savings nearing \$3,600,000 are possible with this changed configuration.

Alignment for Project 42 (A-X (42))

Additional potential savings can be garnered as stated on Alternative A-4 (42) by using a one-way pair solution with the existing west end alignment and culvert over Clark Creek as the westbound traffic and using the proposed new alignment with only one two-lane bridge structure spanning Clark Creek further south than the existing crossing as the eastbound traffic route. Savings of over \$8,300,000 are deemed possible.

If it were possible to re-align the proposed new alignment further south of the proposed alignment at the west end of the project, savings in the vicinity of \$3,500,000 would be feasible but would entail a major redesign effort and require additional environmental investigations and approvals. These findings are narrated on Alterative A-14 (42).

Roadway for Project 42 (R-X (42))

Three major reconfigurations were studied for this section of the SR 92 corridor. Although the savings are incredibly high, they are primarily derived from right-of-way savings which, as noted in the paragraph labeled *Concerns*, appear to be overstated and should be further investigated by GDOT. Notwithstanding, there are three possible alternatives. R-1 (42) - Reducing the median width to 6.1 meters from the currently proposed 13.6 meters which could realize initial savings nearing \$12,000,000. This alternative acknowledges the loss of potential future widening to six lanes in the center of the project. R-2 (42) - Reducing the median width to 1.8 meters from the currently proposed 13.6 meters requires the use of concrete barriers but could still realize initial savings of about \$11,700,000. This situation would preclude any future expansion in the middle in the facility. R-12 (42) – Widen to five lanes only and use the center fifth lane as a continuous left turning lane establishes savings close to \$13,900,000.

Alignment for Project 40 (A-X (40))

Two alternatives, A-5 (40) and A-8 (40), address potential safety concerns with very close turning lanes, crossing movements, and proposed intersections and are provided not for their cost savings but for the betterment of traffic flow and safety. A-5 (40) would eliminate the median opening at Quail Run while A-8 (40) would do the same at STA 95+875. They identify savings of about \$135,000 and \$161,000, respectively.

Roadway for Project 40 (R-X (40))

As noted above for Project 42, Alternatives R-1 (40), R-2 (40) and R-10 (40) would reduce the median to 6.1 meters; reduce the median to 1.8 meters with barriers; and use a five-lane solution for Project 40. Corresponding savings are noted to be \$4,560,000, \$3,540,000, and \$3,565,000, respectively.

This segment of the SR 92 corridor employs the use of cast-in-place concrete retaining walls at numerous locations through the project length. Alternative R-14 (40) would use mechanically-stabilized earth walls in lieu of the proposed gravity retaining walls and denotes savings of almost \$225,000. Alternative R-16 (40) would use keystone walls in lieu of the noted gravity retaining walls and could potentially save \$570,000.

Summary of Potential Cost Savings worksheets follow this section. They indicate all of the alternatives and design suggestions developed by the VE team. Some of the alternatives are mutually exclusive or interrelated so that addition of all project cost savings does not equal total savings for the project. A full listing of all of the ideas can be found in Section 4 of this report as *Creative Idea Listing* worksheets.



SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

PRESENT WORTH OF COST SAVINGS

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
	BRIDGE FOR PROJECT 42 (B-x (42))					
B-1 (42)	Span Clark Creek with a shortened bridge and use existing embankment for fill material	\$5,635,239	\$3,621,771	\$2,013,468		\$2,013,468
B-2 (42) et. al.	From existing culvert at Clark Creek, realign SR 92 to approximately STA 88+100	\$8,751,040	\$5,184,360	\$3,566,680		\$3,566,680
B-4 (42)	Use a singe four-lane bridge with sidewalks and no median	\$0	\$4,808,442	(\$4,808,442)		(\$4,808,442)
B-6 (42)	Use a culvert in lieu of bridge structures to span Clark Creek	\$5,635,239	\$4,833,465	\$801,774		\$801,774
B-10 (42)	Eliminate sidewalks on bridge	\$34,910	\$0	\$34,910		\$34,910
B-11 (42)	Reduce width of bridge shoulders by reducing the width of the sidewalks	\$5,635,239	\$4,808,558	\$826,681		\$826,681
B-17 (42)	Use AASHTO Type IV girders in lieu of Bulb-Tee 63 beams	\$1,756,196	\$1,737,733	\$18,463		\$18,463
	ALIGNMENT FOR PROJECT 42 (A-x (42))					
A-4 (42)	Use a one-way pair solution with existing culvert and a new two-lane bridge	\$23,497,033	\$15,143,865	\$8,353,168		\$8,353,168
A-5 (42)	Maintain Hunt Road Alignment	\$2,757,577	\$754,782	\$2,002,795		\$2,002,795
A-8 (42)	Eliminate James Dupree Road access to SR 92 and reconnect to relocated Little Ridge Road	\$0	\$883,805	(\$883,805)		(\$883,805)
A-10 (42)	Shift proposed alignment to reuse/resurface existing roadway	\$641,565	\$0	\$641,565		\$641,565
A-14 (42)	Realign western portion of Project 42	\$23,428,758	\$19,918,678	\$3,510,080		\$3,510,080
	ROADWAY FOR PROJECT 42 (R-x (42))					
R-1 (42)	Reduce median width to 6.1 meters	\$54,722,093	\$42,625,595	\$12,096,498		\$12,096,498
R-2 (42)	Reduce median width to 1.8 meters	\$55,442,143	\$43,699,995	\$11,742,148		\$11,742,148
R-6 (42)	Eliminate sidewalks from Northpoint Parkway to Woodland Drive	\$700,969	\$0	\$700,969		\$700,969
R-7 (42)	Do not obliterate pavement	\$76,926	\$0	\$76,926		\$76,926
R-12 (42)	Use a five-lane section for widening	\$53,281,993	\$39,428,675	\$13,853,318		\$13,853,318



SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

PRESENT WORTH OF COST SAVINGS

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ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
	ALIGNMENT FOR PROJECT 40 (A-x (40))					
A-1 (40)	Shift proposed alignment to reuse/resurface existing roadway	\$615,617	\$0	\$615,617		\$615,617
A-5 (40)	Eliminate median break at Quail Run (STA 95+373)	\$134,924	\$0	\$134,924		\$134,924
A-8 (40)	Eliminate median break at STA 95+875	\$160,696	\$0	\$160,696		\$160,696
	ROADWAY FOR PROJECT 40 (R-x (40))					
R-1 (40)	Reduce median width to 6.1 meters	\$15,528,820	\$10,967,696	\$4,561,124		\$4,561,124
R-2 (40)	Reduce median width to 1.8 meters	\$16,135,220	\$12,596,817	\$3,538,403		\$3,538,403
R-4 (40)	Eliminate sidewalks from Woodland Drive to Cherokee Trail	\$433,879	\$0	\$433,879		\$433,879
R-5 (40)	Do not obliterate pavement	\$17,788	\$0	\$17,788		\$17,788
R-10 (40)	Use a five-lane section for widening	\$13,709,620	\$10,145,119	\$3,564,501		\$3,564,501
R-13 (40)	Reduce height of retaining walls and provide railing	\$1,432,620	\$1,106,074	\$326,546		\$326,546
R-14 (40)	Use mechanically stabilized earth walls in lieu of gravity retaining walls	\$1,432,620	\$1,207,949	\$224,671		\$224,671
R-16 (40)	Use keystone walls in lieu of gravity retaining walls	\$1,432,620	\$859,572	\$573,048		\$573,048

STUDY RESULTS

INTRODUCTION

The results are the major feature of a value engineering study since they represent the benefits that can be realized on the project by the owner, users and designer. The results will directly affect the project design and will require coordination among the designer, the user, and the owner to determine the ultimate acceptance of each alternative.

The creative ideas are organized according to the order in which they were originally generated by the VE team during its function analysis creative sessions. The following prefixes in the alternative numbers are use to designate the project element being addressed:

B (42) = Bridge for Project 42 **A** (42) = Alignment for Project 42 **R** (42) = Roadwork for Project 42 **A** (40) = Alignment for Project 40 **R** (40) = Roadwork for Project 40

RESULTS OF THE STUDY

The VE team generated 70 ideas for change during the Function Analysis and Creative Ideas phases of the VE Job Plan. The evaluation of these ideas was based upon their potential for capital cost savings, probability of acceptance, availability of information to properly develop an idea, compliance with perceived quality, adherence to universally accepted standards and procedures, life cycle cost efficiency, safety, maintainability, constructibility, and soundness of the idea.

Of the 70 ideas generated, 36 were sufficiently rated to warrant further investigation. Continued research and development of these ideas yielded 31 alternatives for change with an impact on project costs. All of these alternatives are presented in detail following this narrative and on the *Summary of Potential Cost Savings* worksheets.

EVALUATION OF ALTERNATIVES

It is important to consider each part of an individual alternative on its own merit. There may be a tendency to disregard an alternative because of concern about one portion of it. Consider each of the areas within an alternative that are acceptable and implement those parts in the final design, even if the entire alternative is not implemented.

Cost is the primary basis of comparison for alternative designs. To ensure that costs are comparable within the alternatives proposed by the VE team, the designer's cost estimates, where possible, should

be used as the pricing basis. Where appropriate, the impact of energy costs, replacement costs, and effect on operations and maintenance should be shown within each alternative.

Some of the alternatives are interrelated, so acceptance of one may preclude the acceptance of another. The reader should evaluate those alternatives carefully to select the ideas with the greatest beneficial impact to the project.



SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

PRESENT WORTH OF COST SAVINGS

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
	BRIDGE FOR PROJECT 42 (B-x (42))					
B-1 (42)	Span Clark Creek with a shortened bridge and use existing embankment for fill material	\$5,635,239	\$3,621,771	\$2,013,468		\$2,013,468
B-2 (42) et. al.	From existing culvert at Clark Creek, realign SR 92 to approximately STA 88+100	\$8,751,040	\$5,184,360	\$3,566,680		\$3,566,680
B-4 (42)	Use a singe four-lane bridge with sidewalks and no median	\$0	\$4,808,442	(\$4,808,442)		(\$4,808,442)
B-6 (42)	Use a culvert in lieu of bridge structures to span Clark Creek	\$5,635,239	\$4,833,465	\$801,774		\$801,774
B-10 (42)	Eliminate sidewalks on bridge	\$34,910	\$0	\$34,910		\$34,910
B-11 (42)	Reduce width of bridge shoulders by reducing the width of the sidewalks	\$5,635,239	\$4,808,558	\$826,681		\$826,681
B-17 (42)	Use AASHTO Type IV girders in lieu of Bulb-Tee 63 beams	\$1,756,196	\$1,737,733	\$18,463		\$18,463
	ALIGNMENT FOR PROJECT 42 (A-x (42))					
A-4 (42)	Use a one-way pair solution with existing culvert and a new two-lane bridge	\$23,497,033	\$15,143,865	\$8,353,168		\$8,353,168
A-5 (42)	Maintain Hunt Road Alignment	\$2,757,577	\$754,782	\$2,002,795		\$2,002,795
A-8 (42)	Eliminate James Dupree Road access to SR 92 and reconnect to relocated Little Ridge Road	\$0	\$883,805	(\$883,805)		(\$883,805)
A-10 (42)	Shift proposed alignment to reuse/resurface existing roadway	\$641,565	\$0	\$641,565		\$641,565
A-14 (42)	Realign western portion of Project 42	\$23,428,758	\$19,918,678	\$3,510,080		\$3,510,080
	ROADWAY FOR PROJECT 42 (R-x (42))					
R-1 (42)	Reduce median width to 6.1 meters	\$54,722,093	\$42,625,595	\$12,096,498		\$12,096,498
R-2 (42)	Reduce median width to 1.8 meters	\$55,442,143	\$43,699,995	\$11,742,148		\$11,742,148
R-6 (42)	Eliminate sidewalks from Northpoint Parkway to Woodland Drive	\$700,969	\$0	\$700,969		\$700,969
R-7 (42)	Do not obliterate pavement	\$76,926	\$0	\$76,926		\$76,926
R-12 (42)	Use a five-lane section for widening	\$53,281,993	\$39,428,675	\$13,853,318		\$13,853,318

VALUE ENGINEERING ALTERNATIVE



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-1 (42)

DESCRIPTION: SPAN CLARK CREEK WITH A SHORTENED BRIDGE AND

USE EXISTING EMBANKMENT FOR FILL MATERIAL

SHEET NO.: 1 of 11

ORIGINAL DESIGN: (Sketch attached)

The current design calls for the use of two, 2-lane bridge structures to span Clark Creek on the new alignment. One bridge will accommodate eastbound traffic and the second bridge will accommodate westbound traffic. The existing culvert crossing of Clark Creek is to be abandoned.

ALTERNATIVE: (Sketch attached)

Along the new alignment, provide embankment approaches to shortened bridges spanning Clark Creek. Use the existing embankment of Clark Creek as the fill material for the new approaches.

ADVANTAGES:

- Takes advantage of an existing asset embankment of Clark Creek
- Considerable initial cost savings
- Eliminates superelevation over bridge section near STA 86+530
- Eliminates difficulty in screeding pavement at bridge deck
- Removal of existing embankment reclaims large area of wetland
- Minimizes transportation cost for borrowed material

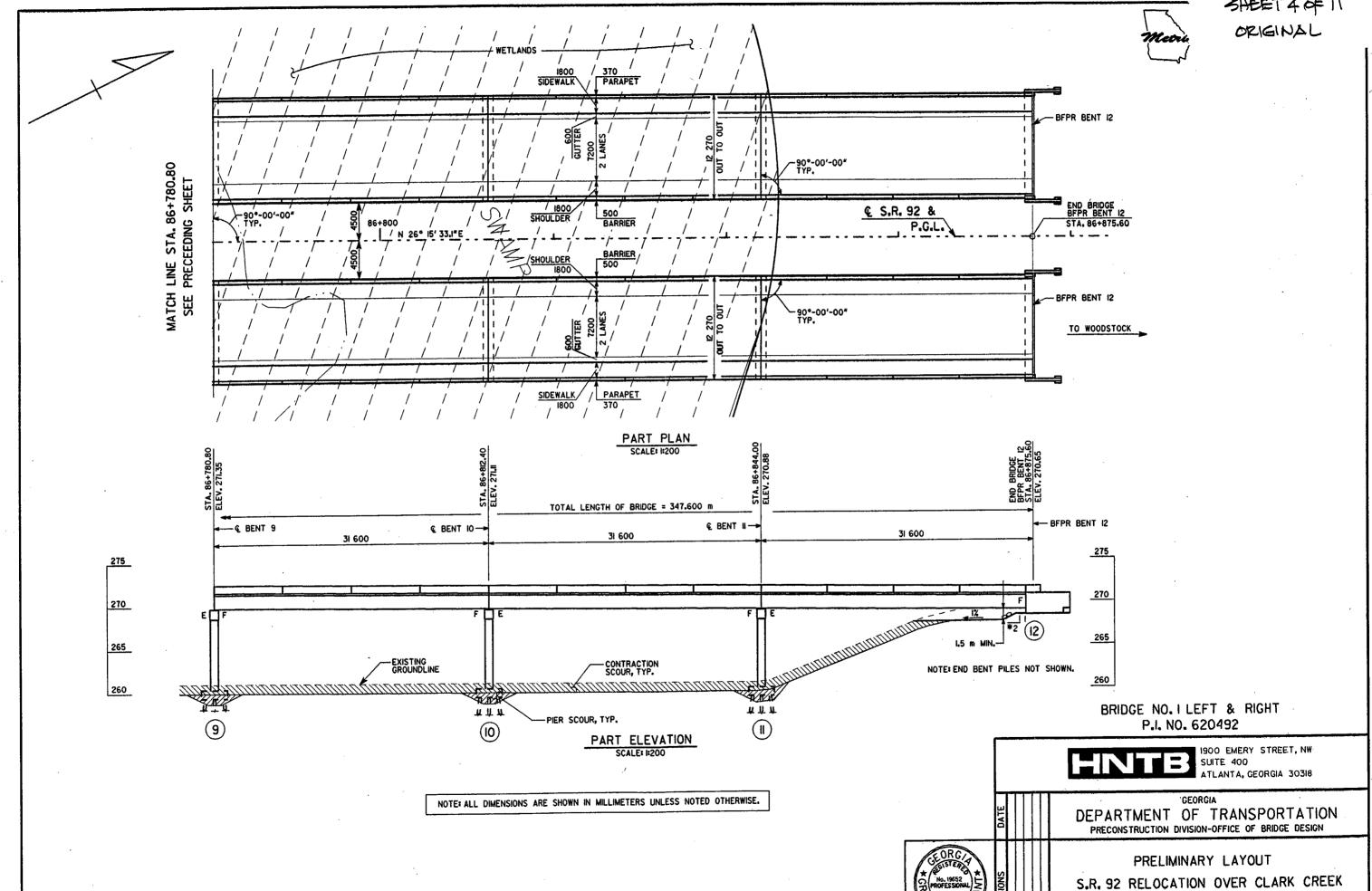
DISADVANTAGES:

- May have to surcharge embankment over wetlands to overcome initial settlement
- May require EPA permitting
- May involve Corps of Engineers input/approval

DISCUSSION:

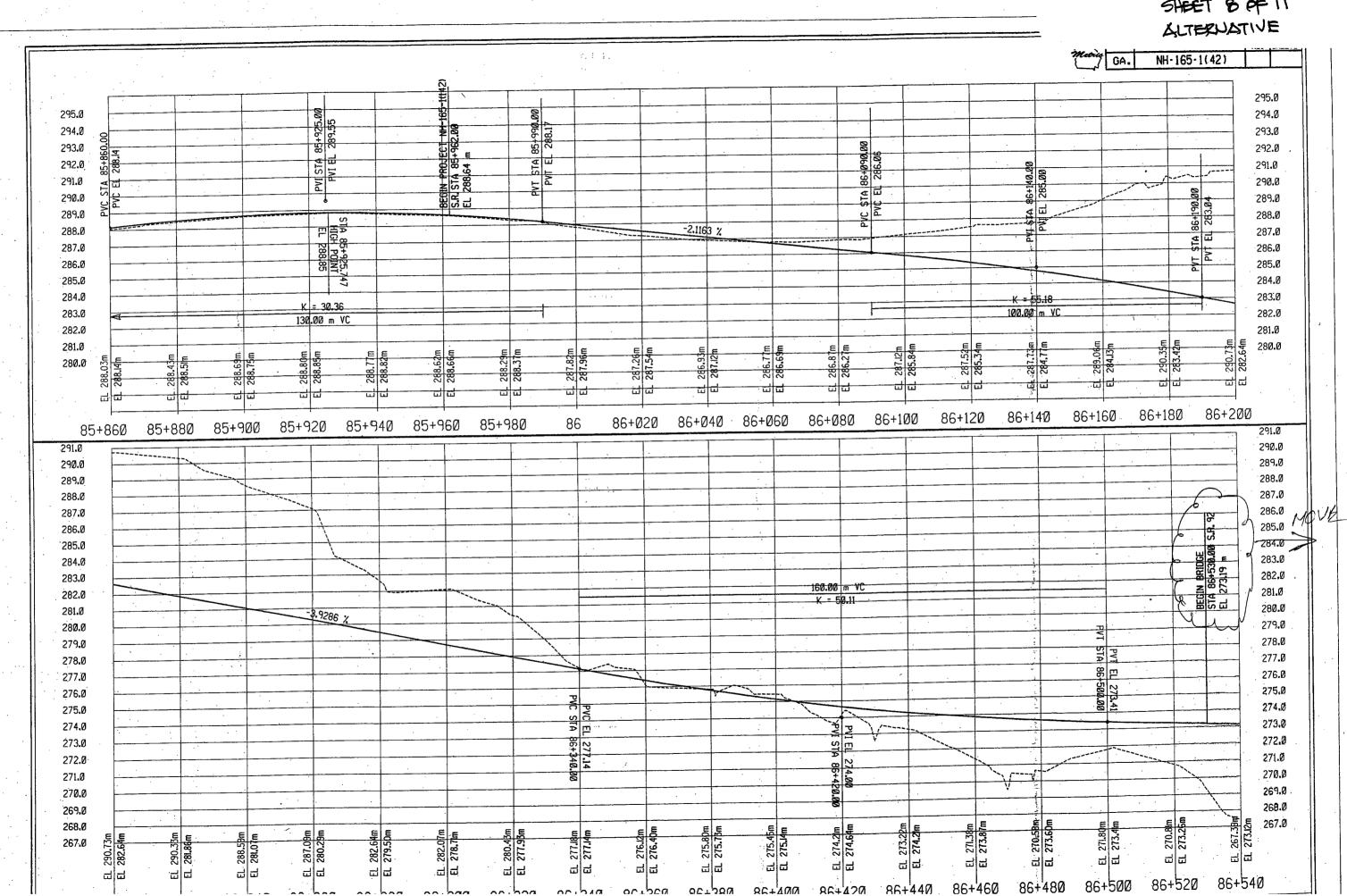
The original 347.600 meter bridge can be shortened by approximately 275 meters by spanning over the creek only. The remaining length could be filled (embankment) with material borrowed from the abandoned alignment of SR 92 over Clark Creek.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	5,635,239	3/4	\$	5,635,239
ALTERNATIVE	\$	3,621,771	3/4	\$	3,621,771
SAVINGS	\$	2,013,468	3/4	\$	2,013,468



AUERNATIVE BFPR BENT 12 /-90°-00'-00" TYP. MATCH LINE STA. 86+780.80 SEE PRECEEDING SHEET SHOULDER 1800 € S.R. 92 & -90***-**00**'-**00**"** . TYP. P.G.L. BFPR BENT 12 -90°-00'-00" TYP. TO WOODSTOCK PART PLAN SCALE: 1:200 TOTAL LENGTH OF BRIDGE = 347,600 m - BFPR BENT 12 € BENT II --- & BENT 9 & BENT 10-31 600 31 600 31 600 275 275 270 270 265 265 NOTE: END BENT PILES NOT SHOWN. 260 BRIDGE NO. I LEFT & RIGHT P.I. NO. 620492 -PIER SCOUR, TYP. PART ELEVATION
SCALE: #200 1900 EMERY STREET, NW SUITE 400 GEORGIA NOTE: ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS NOTED OTHERWISE. DEPARTMENT OF TRANSPORTATION PRECONSTRUCTION DIVISION-OFFICE OF BRIDGE DESIGN PRELIMINARY LAYOUT S.R. 92 RELOCATION OVER CLARK CREEK

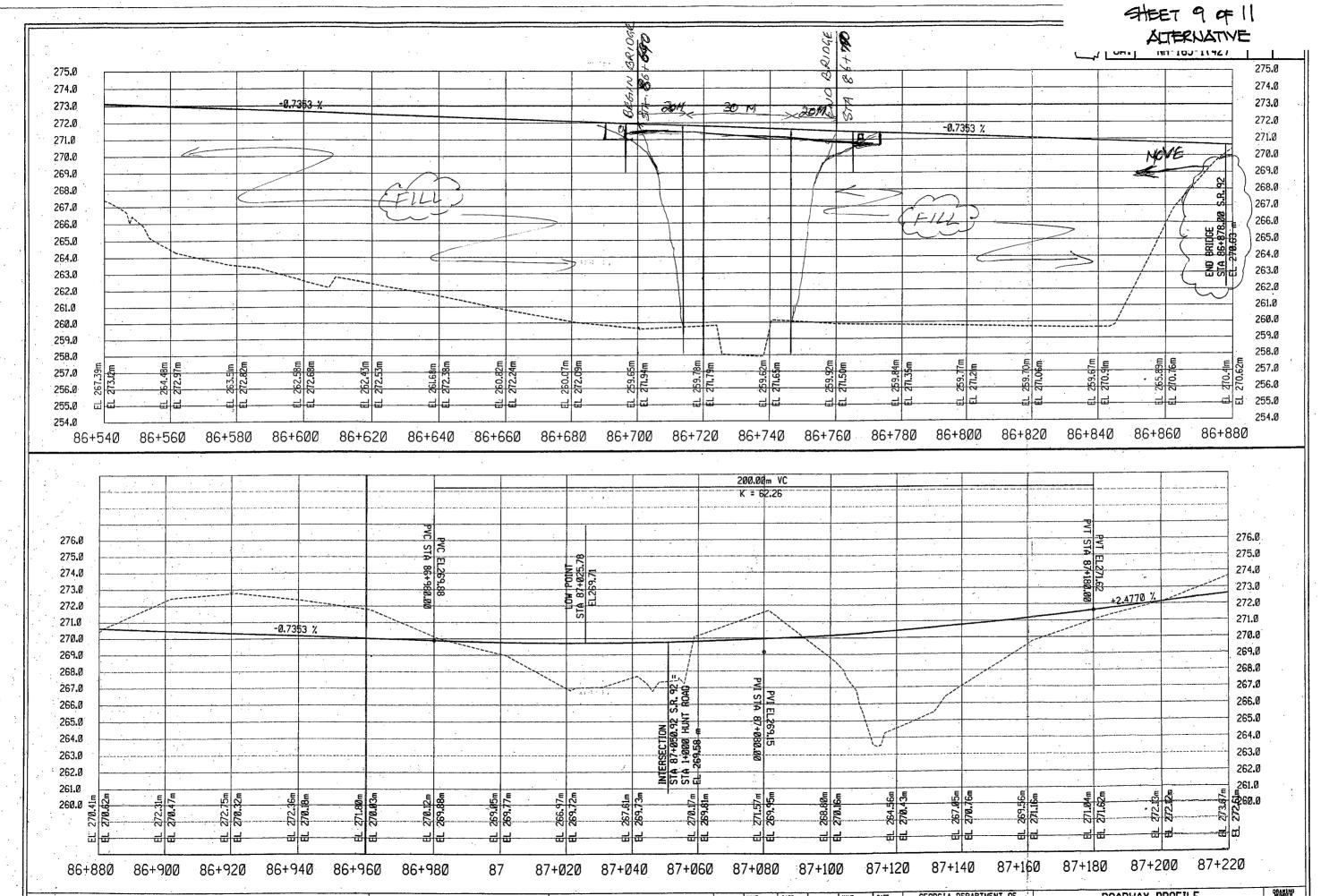
B-1 (42) SHET BOF 11



B-1(42)



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CALCULATIONS



PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

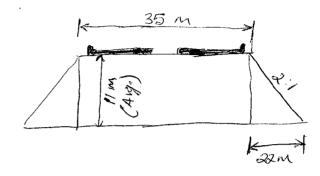
ALTERNATIVE NO.:

13-1(42)

DESCRIPTION:

SHEET NO .: 10 of 11

EARTH WORK:



ASSUME:

Average fill height = 11m Average length of fill = 347.6-70 = 277.6 m

Cooss Sectional Area of Embankment = $35 \times 11 + 2 \times 1 \times 2 \times 11$ = 385 + 242= 627 M^3 Volume of Earthwork = $277.6 \times 627 = 174,055 \text{ M}^3$ Length of Bridge = 70 m

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

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ALTERNATIVE NO.:

B-1 (42)

DESCRIPTION: SHEET NO. 11 of 11

CONSTRUCTION ITEM	(ORIGINAL ES	TIMATE	PROPOSED ESTIMATE			
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge	m	347	14,553.17	5,049,950	70	14,553.17	1,018,722
Markup at 11.59%				585,289			118,070
Subtotal				5,635,239			1,136,792
Earthwork	m ³				174,055	8.00	1,392,440
Paved Section	m				278	1,200.00	333,120
Subtotal	l						1,725,560
Markup at 44.01%							759,419
Subtotal	l						2,484,979
Sub-total				5,635,239			3,621,771
Mark-up at				INCL			INCL
TOTAL				5,635,239			3,621,771

VALUE ENGINEERING ALTERNATIVE



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-2 (42), et. al.

SHEET NO.: 1 of 4

DESCRIPTION: REALIGN SR 92 FROM EXISTING CULVERT AT CLARK

CREEK TO STA 88+100±

ORIGINAL DESIGN: (Sketch attached)

The current design calls for a symmetrical alignment throughout the length of the project with new crossings, left turn lanes, and improved accessibility.

ALTERNATIVE: (Sketch attached)

Maintain the existing SR 92 alignment and culvert at the west end of the project; extend the culvert and construct parallel roadway next to existing alignment. Realign remainder of SR 92 to Old Alabama Road.

ADVANTAGES:

- Takes advantage of an existing asset
- Initial cost savings
- Eliminates bridges and future maintenance
- Mimics existing conditions more closely
- Minimizes "reconditioning" of driver expectations

DISADVANTAGES:

- Will require fill-in of wetlands vs. spanning with bridge no different than current conditions
- Loss of some flood storage
- May require EPA permitting
- May involve Corps of Engineers input/approval

DISCUSSION:

This alternative maintains the current/existing roadway alignment at Clark Creek crossing and will provide for a conventional roadway widening along the existing alignment. The drawback of this scheme is that a larger area of the wetlands will be disturbed, filled-in as opposed to spanning. However, it mimics existing conditions more closely. If the Corps of Engineers is requiring that the existing opening be maintained to prevent flooding, then this alternative continues the philosophy. This alternative basically trades off the bridge costs for remediation of the wetlands. Another benefit would be the salvation of more of the existing roadway.

Note: This alternative is a combination of Alternative Nos. B-1 (42), A-1 (42), A-2 (42), and A-3 (42).

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	8,751,040	3/4	\$	8,751,040
ALTERNATIVE	\$	5,184,360	3/4	\$	5,184,360
SAVINGS	\$	3,566,680	3/4	\$	3,566,680

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

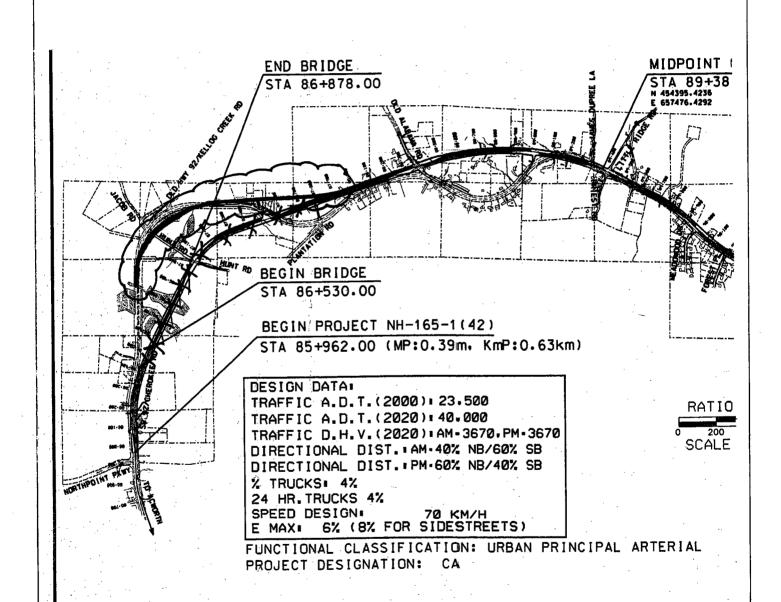
AS DESIGNED

ALTERNATIVE

ALTERNATIVE NO.:

8-2 (42) et. al.

SHEET NO.: 2 of 4



THE DATA. TOGETHER WITH ALL OTHER INFORMATION SHOWN ON THESE PLANS OR IN ANYWAY INDICATED THEREBY. WHETHER BY DRAWINGS OR NOTES. OR IN ANY OTHER MANNER. ARE BASED UPON FIELD INVESTIGATIONS AND ARE BELIEVED TO BE INDICATIVE OF ACTUAL CONDITIONS. HOWEVER. THE SAME ARE SHOWN AS INFORMATION ONLY. ARE NOT GUARANTEED. AND DO NOT BIND THE DEPARTMENT OF TRANSPORTATION IN ANY WAY. THE ATTENTION OF BIDDER IS SPECIFICALLY DIRECTED TO SUBSECTIONS 102.04. 102.05. AND 104.03 OF THE SPECIFICATIONS.

THIS PROJECT IS LOCATED 100% IN CHEROK THIS PROJECT IS LOCATED 100% IN CONGRE

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

75-2(42) et.al.

SHEET NO .: 3 of 4

DESCRIPTION:

ASSUME SUGHTLY WHERE POMPUMY ALICHMENT -USE 200 M

CULVERT ASSUME - TRIPLE - 8 X10 - USE \$500,000

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-2 (42), et. al.

DESCRIPTION: SHEET NO. 4 of 4

CONSTRUCTION ITEM			IMATE	PROPOSED ESTIMATE			
UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
m	347	14,553.17	5,049,950				
			585,289				
			5,635,239				
lm	1,803	1,200.00	2,163,600	2,000	1,200.00	2,400,000	
1s				1		500,000	
1s				1		700,000	
			2,163,600			3,600,000	
			952,200			1,584,360	
			3,115,800			5,184,360	
			8,751.040			5,184,360	
						INCL	
						5,184,360	
	lm	UNITS NO. OF UNITS m 347 Im 1,803 ls	UNITS NO. OF UNITS UNIT m 347 14,553.17 Im 1,803 1,200.00 ls	UNITS UNIT 101AL m 347 14,553.17 5,049,950 585,289 5,635,239 lm 1,803 1,200.00 2,163,600 ls 2,163,600 952,200	UNITS	UNITS	

VALUE ENGINEERING ALTERNATIVE



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-4(42)

DESCRIPTION: USE A SINGLE FOUR-LANE BRIDGE WITH SIDEWALKS

AND NO MEDIAN

SHEET NO.: 1 of 5

ORIGINAL DESIGN: (Sketch attached)

The current design calls for the use of two, 2-lane bridge structures to span Clark Creek on the new alignment. One bridge will accommodate eastbound traffic and the second bridge will accommodate westbound traffic. The existing culvert crossing of Clark Creek is to be abandoned.

ALTERNATIVE: (Sketch attached)

Along the new alignment, provide a single bridge structure accommodating four lanes with sidewalks on both sides. Eliminate the median.

ADVANTAGES:

DISADVANTAGES:

- Could eliminate one column per intermediate bent
- Ease of construction
- Eliminate a pair of railings
- Provide the same number of lanes as original design

None apparent

DISCUSSION:

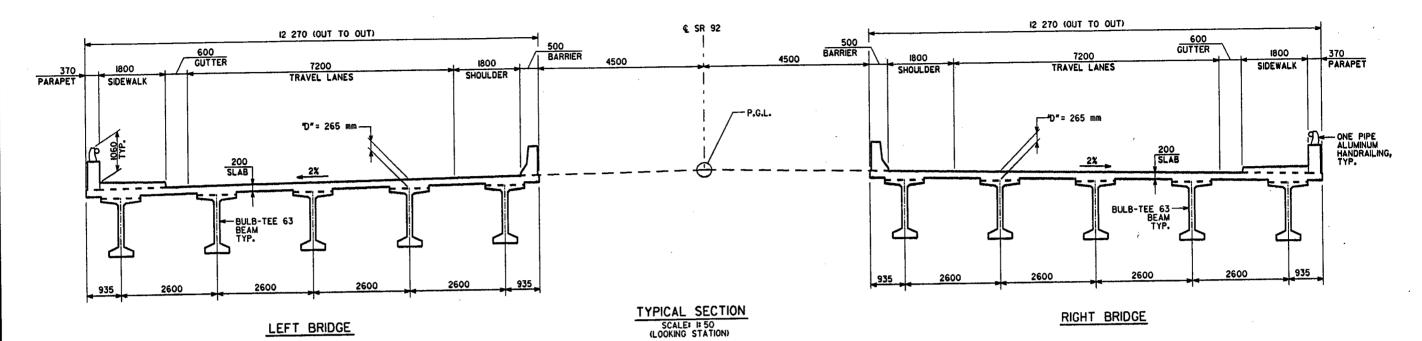
The use of a single structure in lieu of two to accommodate the immediate need of four travel lanes is not only less costly up front, but reduces overall operation and maintenance costs. If future expansion is required, it would be easier to accomplish to the outside of the travel lanes. Furthermore, this design facilitates maintenance of traffic during the widening period.

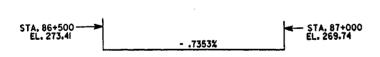
As noted on the calculation sheet, a more refined cost analysis would show cost savings due to the elimination of the inside barrier rails, and possibly one column per bent and associated footings and piles.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	0	3/4	\$	0
ALTERNATIVE	\$	4,808,442	3/4	\$	4,808,442
SAVINGS	\$	(4,808,442)	3/4	\$	(4,808,442)

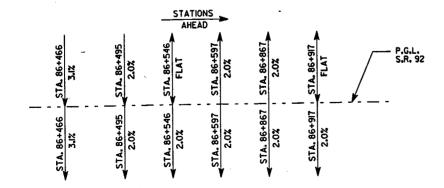
B-H (H2) ORIGINAL DESIGN







PROPOSED GRADE DATA



SUPERELEVATION TRANSITION DATA

	DRAINAGE D	ATA ***	
DR	AINAGE AREA = 198	I.OI HECTARES	
FLOOD FREQUENCY	DISCHARGE *	AREA **	MEAN VELOCITY
50-YEAR	132.30 m³/S	171.68 m²	0.77 m/S
IOO-YEAR	151.82 m³/S	182.74 m²	0.83 m/S
500-YEAR	180.91 m ³ /S	202.62 m²	0.89 m/S

NOTE: ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS NOTED OTHERWISE.

- # THROUGH THE BRIDGE

 #* AREA OF THE OPENING BELOW HIGH WATER (m2)

 *** AREAS AND MEAN VELOCITIES CORRESPOND TO ANALYSIS

 CASE 3 WHERE CLARK CREEK CONTROLS THE FLOW.

THEORETICAL SCOUR DEPTHS (m)								
BENT	100	YEAR ST	TORM	500	YEAR ST	ORM		
LOCATION	GEN.	LOCAL	TOTAL	GEN.	LOCAL	TOTAL		
BENT 2	0.691	0.000	0.69	L042	0.000	I _• 042		
BENT 3	0.691	0.000	0.691	1.042	0.000	1.042		
BENT 4	0.691	0.000	0.691	L042	0.000	1.042		
BENT 5	0.691	0.000	0.691	1.042	0.000	1.042		
BENT 6	0.691	0.988	1.679	1.042	0.945	1.987		
BENT 7	0.691	L030	1.721	1.042	0.978	2.020		
BENT 8	0.691	0.899	1.590	L042	L164	2.206		
BENT 9	0.691	0.939	1.630	1.042	1.247	2.289		
BENT IO	0.69i	0,960	1.651	1.042	1.271	2.313		
BENT II	0.691	0.975	1.666	1,042	L286	2.328		

EACH BRIDGE CONSISTS OF:

H - 31.6 m PSC BEAM SPANS	SPECIAL	DESIGN
2 - PILE END BENTS	SPECIAL	DESIGN

DESIGN DATA:

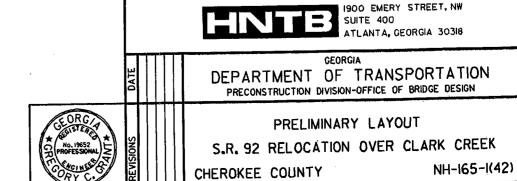
SPECIFICATIONS -			A/	ASHTO 1996	
TYPICAL MSI8-44	AND/OR MILITARY	LOADING		IMPACT ALLOY	۷Į
FUTURE WEARING	SURFACE			0.72 KN/M2	

TRAFFIC DATA:

TRAFFIC		ADT	=	10,500	(2000
	SPEED	70	KN		

BRIDGE NO. I LEFT & RIGHT P.I. NO. 620492

NOVEMBER 1999



SCALE: AS SHOWN

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

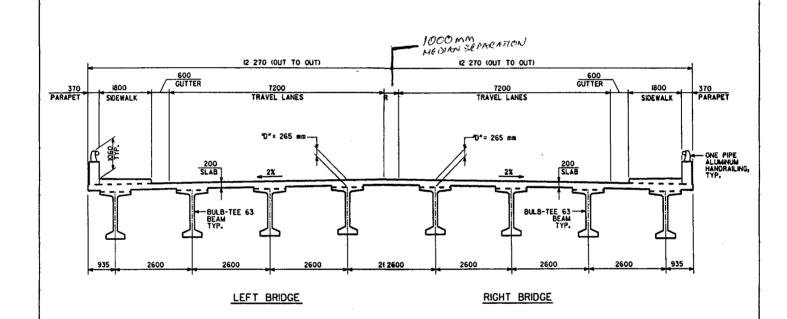
ALTERNATIVE NO.:

8-4(42)

☐ AS DESIGNED

☑ ALTERNATIVE

SHEET NO .: 3 of 5



CALCULATIONS

PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

7-4(42)

DESCRIPTION:

SHEET NO.: 4 of 5

PRORATING BRIDGE COST:

COST PER BRIDGE FOR CRIGINAL DESIGN = \$5,049,950

z \$ 2,524,975

DECK AREA = 347.6 x 12.270

= 4265.05 M2

PRICE PER H2 = \$ 592 /M2

ALTERNATE DESIGN

WILLD'TH OF ALTERNATE CROSS SECTION = 20 940 M

ALTERNATIVE AREA = 347.6 x 20.94 = 7278.75 M2

COST = 7278.75 x 592 = \$4,309,016

NOTE:

More refined cost analysis would show cost savings due to elimination of inside bassier rails, possibly a RC Column per bent and footing/piles associated with it.

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-4 (42)

DESCRIPTION: SHEET NO. 5 of 5

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE			
ITEN	М	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge Deck		m ²				7,278.76	592.00	4,309,026
B.C	Sub-total							4,309,026
Mark-up at	11.59%							499,416
	TOTAL							4,808,442

VALUE ENGINEERING ALTERNATIVE



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-6(42)

SHEET NO.: 1 of 11

DESCRIPTION: USE A CULVERT IN LIEU OF BRIDGE STRUCTURES TO

SPAN CLARK CREEK

ORIGINAL DESIGN: (Sketch attached)

The current design calls for the use of two, 2-lane bridge structures to span Clark Creek on the new alignment. One bridge will accommodate eastbound traffic and the second bridge will accommodate westbound traffic. The existing culvert crossing of Clark Creek is to be abandoned.

ALTERNATIVE: (Sketch attached)

Along the new alignment, provide a new culvert structure to replace the proposed twin bridges over Clark Creek and accommodate the travel four-lanes on a new embankment. Use the existing, to-be-abandoned embankment of Clark Creek as the fill material for the new embankment.

ADVANTAGES:

- Initial cost savings
- Takes advantage of an existing asset embankment at Clark Creek
- Eliminates superelevation over bridge section near STA 86+530
- Eliminates difficulty in screeding pavement at bridge deck
- Removal of existing embankment reclaims large area of wetland
- Minimizes transportation cost for borrowed material
- Controlled stream flow

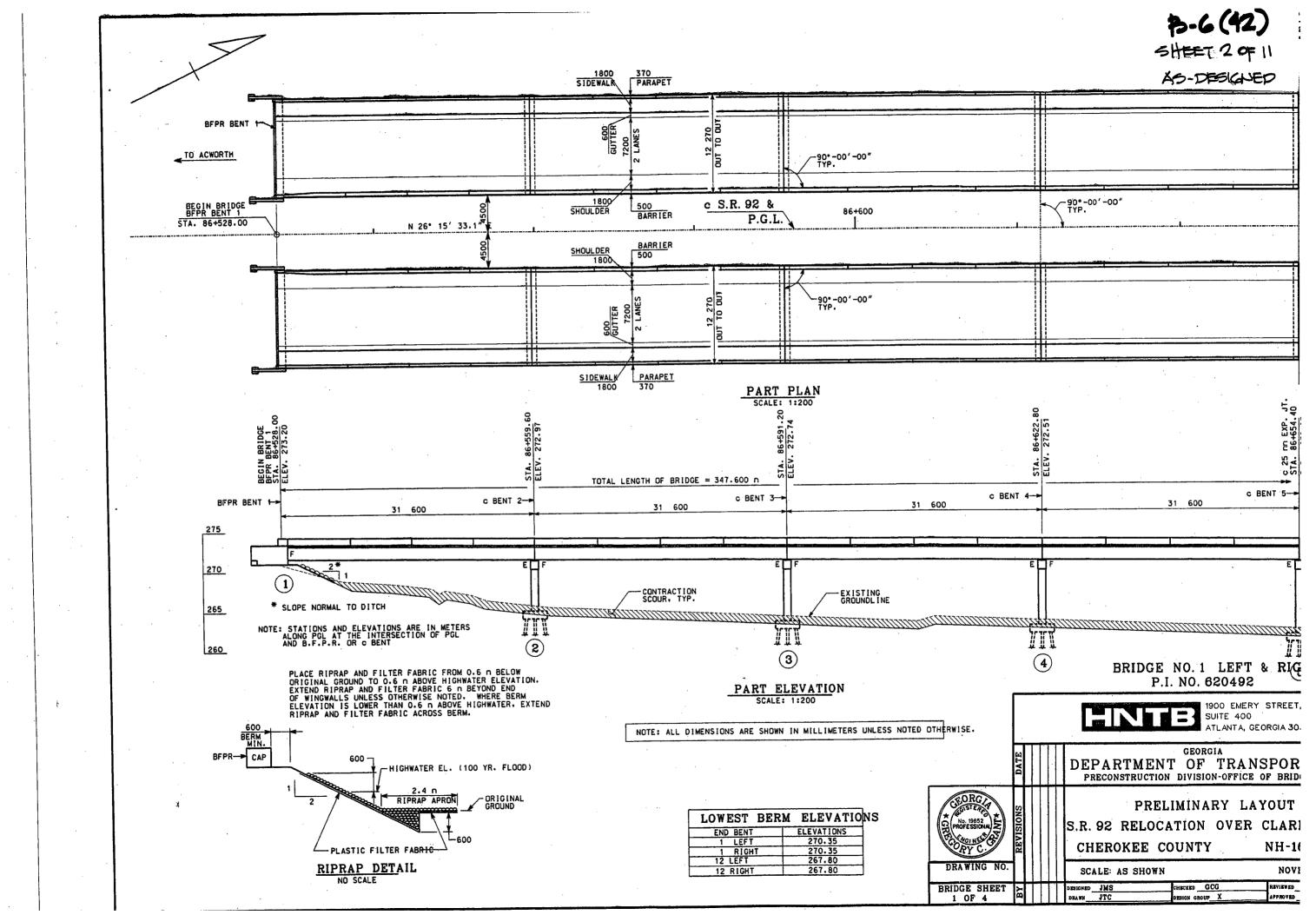
DISADVANTAGES:

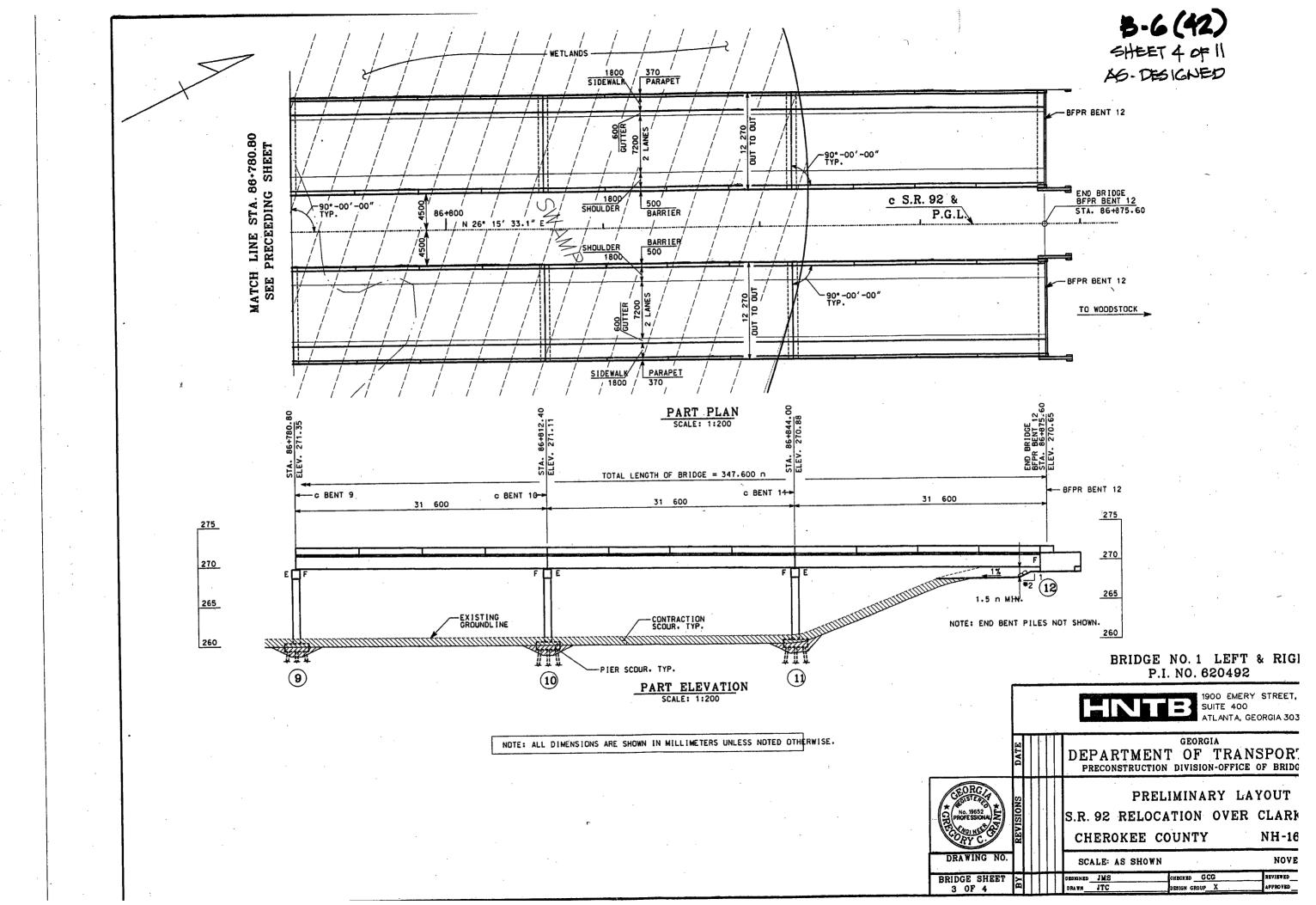
- May have to surcharge embankment over wetlands to overcome initial settlement
- May require EPA permitting
- May involve Corps of Engineers input/approval

DISCUSSION:

The proposed 347.600 meter (m) bridge could be shortened considerably or eliminated in its entirety by using a triple cell box culvert of 60 m x 5 m (three cells 20 m wide by 5 m high) open bottom type. Embankment and / or fill material could be borrowed from the abandoned alignment of SR 92 over Clark Creek.

COST SUMMARY	PRESENT WORTH RECURRING COSTS		PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$ 5,635,239	3/4	\$	5,635,239
ALTERNATIVE	\$ 4,833,465	3/4	\$	4,833,465
SAVINGS	\$ 801,774	3/4	\$	801,774



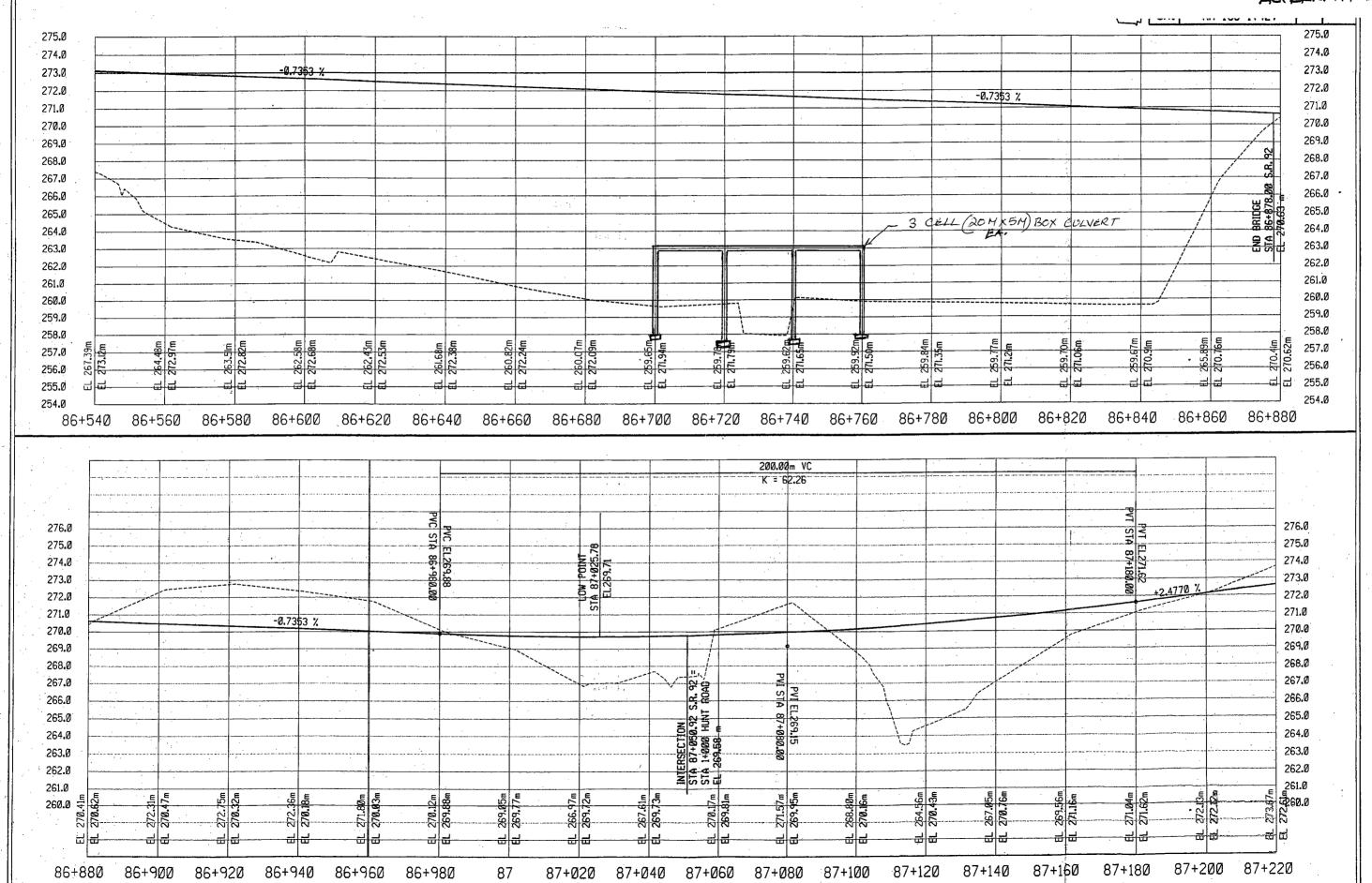


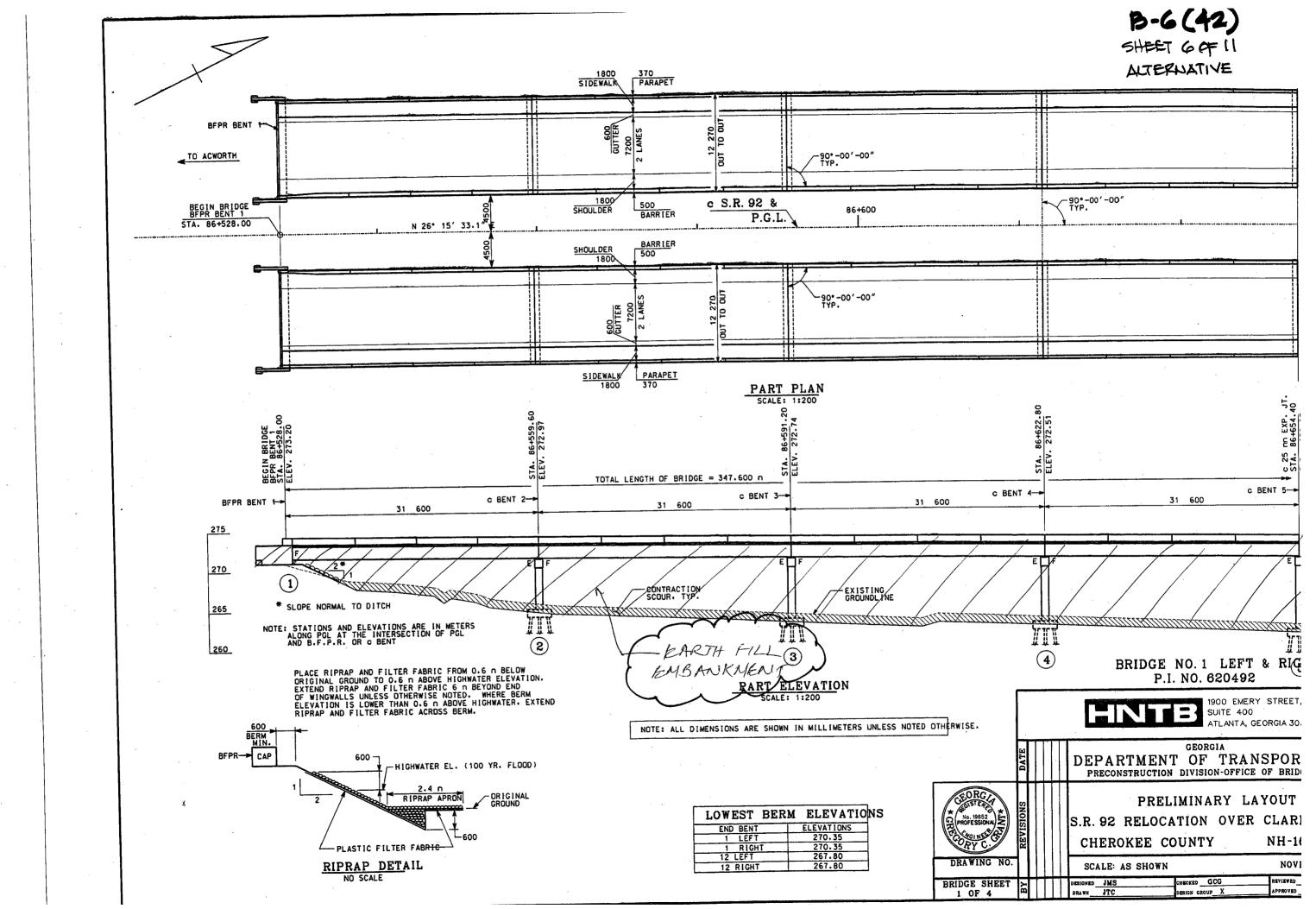
ORAN LNG

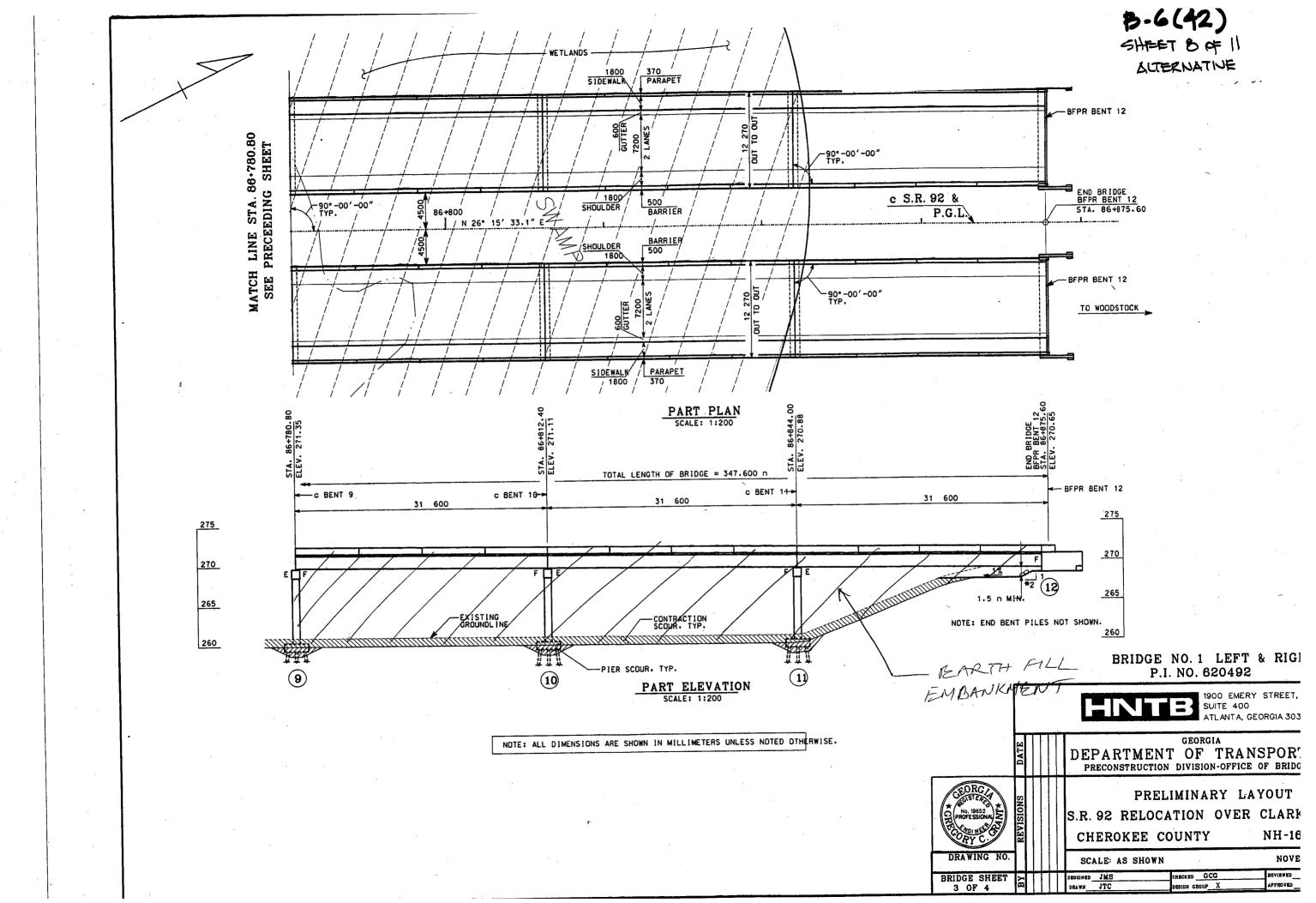
DOADWAY PROFILE

GEORGIA DEPARTMENT OF

SHEET SOF !







CALCULATIONS



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

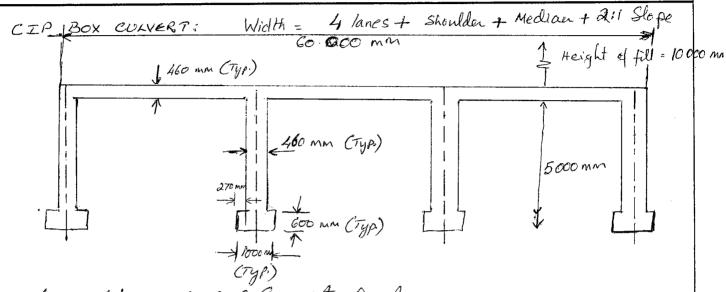
Final Design Development

ALTERNATIVE NO.:

8-6(42)

DESCRIPTION:

SHEET NO .: 9 of 11



Approx Volume of CIP Concrete Rayel:

Area of CS of Culvert = 60.000 mm x 460 + 4x400 x 5000 + 8x270x600 \$\pm\$ 38.10 \times 106 mm^2

[Width of Culvert = 35.2 m (Roadway, incl. shoulders) + 20 m (2:15/6pe)

= 55.2 m]

Volume of CIP = 38.10 x 55.2 = 2103 m3

CALCULATIONS

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

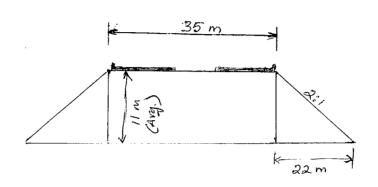
ALTERNATIVE NO .:

8-6 (42)

SHEET NO .: | Q of \

EARTHWORK:

DESCRIPTION:



ASSOME:

Average fill height = 11 m Average length of fili = 290 m Cross Sectional Area of Embankment: 35×11+ 2×1×22×11 z 385 + 242

z 627 M3 VOLUME OF EARTHWORK = 290 × 627 = 181,830 M3
Length of Paved Section = 358 M.

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-6 (42)

CONSTRUCTION ITEM			ORIGINAL EST	TIMATE	PROPOSED ESTIMATE			
ITE	М	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge		m	347	14,553.17	5,049,950			
	Markup at 11.59%				585,289			
	Subtotal				5,635,239			
Culvert / CIP concre	ete	m^3				2,103	700.00	1,472,100
Earthwork		m ³				181,830	8.00	1,454,640
Paved Section		m				358	1,200.00	429,600
	Subtotal							3,356,340
	Markup at 44.01%							1,477,125
	Subtotal							4,833,465
	Sub-total				5 625 020			1 922 465
Markum at	Sup-total				5,635,239			4,833,465
Mark-up at	TOTAL				INCL 5.625.220			INCL
	TOTAL				5,635,239			4,833,465



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-10(42)

DESCRIPTION: ELIMINATE SIDEWALKS ON BRIDGE

SHEET NO.: 1 of 4

ORIGINAL DESIGN: (Sketch attached)

The current design calls for the use of two, 2-lane bridge structures to span Clark Creek on the new alignment. One bridge will accommodate eastbound traffic and the second bridge will accommodate westbound traffic. Sidewalks are noted on both sides of the bridges.

ALTERNATIVE: (Sketch attached)

Eliminate the sidewalks on both sides of the bridges.

ADVANTAGES:

- Initial cost savings
- Not needed
- Reduces weight from girders that could decrease the number of prestressed strands
- Simpler design and construction

DISADVANTAGES:

- Loss of an amenity
- Not in keeping with current GDOT desires

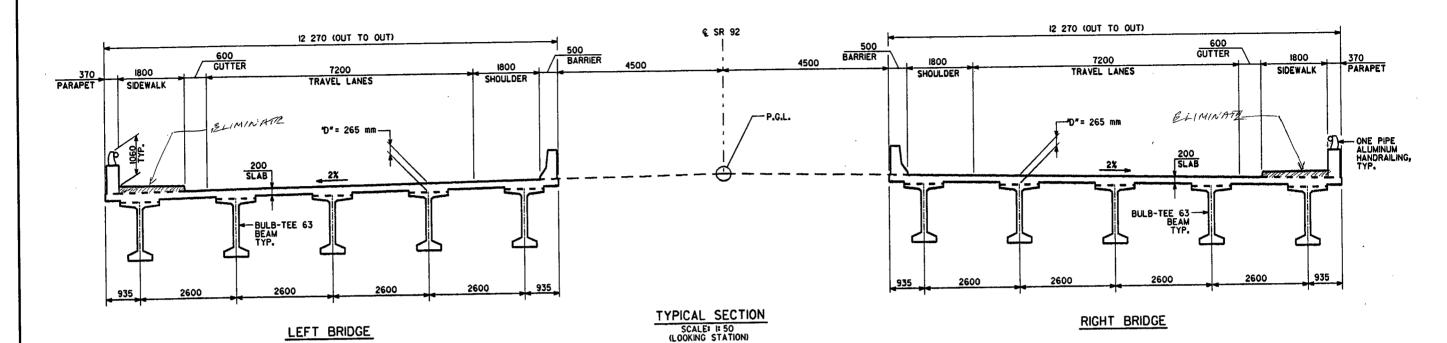
DISCUSSION:

SR-92 at this location traverses a rural area. Therefore, the need for sidewalks on the bridges is not warranted. Eliminating the sidewalks would lessen the load on the girders thus potentially reducing the cost of the girder due to a smaller section. However, these savings have not been included below.

Due to the small amount of savings, this alternative should only be considered as a cost reduction effort.

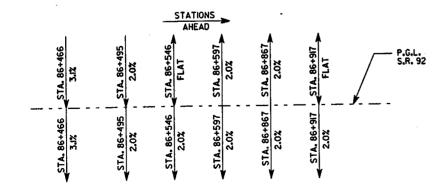
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$ 34,910	3/4	\$	34,910
ALTERNATIVE	\$ 0	3/4	\$	0
SAVINGS	\$ 34,910	3/4	\$	34,910

AG. DEGIGNED & BUTERNATINE



STA. 86+500-EL. 273.41 - .7353%

PROPOSED GRADE DATA



SUPERELEVATION TRANSITION DATA

	DRAINAGE D	ATA ***	
DRA	AINAGE AREA = 198	I.OI HECTARES	
FLOOD FREQUENCY	DISCHARGE *	AREA **	MEAN VELOCITY
50-YEAR	132.30 m³/S	171.68 m²	0.77 m/S
IOO-YEAR	15L82 m³/S	182.74 m²	0.83 m/S
500-YEAR	180.91 m3/S	202.62 m²	0.89 m/S

NOTE: ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS NOTED OTHERWISE.

- * THROUGH THE BRIDGE

 ** AREA OF THE OPENING BELOW HIGH WATER (m²)

 *** AREAS AND MEAN VELOCITIES CORRESPOND TO ANALYSIS
 CASE 3 WHERE CLARK CREEK CONTROLS THE FLOW.

THEORETICAL SCOUR DEPTHS (m)							
BENT	100	YEAR ST	TORM	500 YEAR STORM			
LOCATION	GEN.	LOCAL	TOTAL	GEN.	LOCAL	TOTAL	
BENT 2	0.691	0,000	0.691	L042	0.000	1.042	
BENT 3	0.691	0.000	0.691	1.042	0.000	1.042	
BENT 4	0.691	0.000	0.691	L042	0.000	1.042	
BENT 5	0.691	0.000	0.691	L042	0.000	1.042	
BENT 6	0.691	0.988	1.679	1.042	0.945	1.987	
BENT 7	0.691	1,030	1.721	L042	0.978	2.020	
BENT 8	0.691	0.899	1.590	L042	LI64	2.206	
BENT 9	0.691	0.939	1.630	1,042	1.247	2.289	
BENT IO	0.691	0.960	I . 65I	1,042	L27I	2.313	
BENT II	0.691	0.975	1.666	L042	L286	2.328	

EACH BRIDGE CONSISTS OF:

H - 3L6 m PSC BEAM SPANS	SPECIAL	DESIGN
2 - PILE END BENTS	SPECIAL	DESIGN
10 - CONCRETE INTERMEDIATE BENTS	SPECIAL	DESIGN

DESIGN DATA:

SPECIFICATIONS -				A#	ASHTO 19	96
TYPICAL MSI8-44	AND/OR	MILITARY	LOADING		IMPACT	ALLOWE
FUTURE WEARING	SURFACE				0.72 KM	I\Ms

TRAFFIC DATA:

TRAFFIC	ADT = 10,500 (2000) ADT = 17,850 (2020)
DESIGN SPEED24 HR TRUCKS	- 70 KM/HR - 4 %

BRIDGE NO. I LEFT & RIGHT P.I. NO. 620492

1900 EMERY STREET, NW



S.R. 92 RELOCATION OVER CLARK CREEK NH-165-1(42) CHEROKEE COUNTY

SCALE: AS SHOWN

NOVEMBER 1999

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-10(42)

DESCRIPTION:

SHEET NO.: 3 of 4

WIDTH OF SIDEWALK = 1800 mm (Per Side)

Length of Bridge = 347.6 M

Area of Sidenally = 347.6 x 1800 x 2

= 1251.36 M2

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-10 (42)

CONSTRUCTIO	О	RIGINAL EST	IMATE	PROPOSED ESTIMATE			
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
dewalks	m ²	1,251.36	25.00	31,284			
	Sub-total			31,284			
Mark-up at 11.5	9%			3,626			
	TOTAL			34,910			



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-11 (42)

DESCRIPTION: REDUCE THE WIDTH OF BRIDGE SHOULDERS BY

REDUCING THE WIDTH OF THE SIDEWALKS

SHEET NO.: 1 of 4

ORIGINAL DESIGN: (Sketch attached)

The current design calls for the use of two, 2-lane bridge structures to span Clark Creek on the new alignment. One bridge will accommodate eastbound traffic and the second bridge will accommodate westbound traffic. Sidewalks are noted on both sides of the bridges.

ALTERNATIVE: (Sketch attached)

Use 900 mm wide sidewalks in lieu of 1,800 mm sidewalks and reduce the overall width of the shoulder thereby reducing the size of the twin bridges.

ADVANTAGES:

DISADVANTAGES:

- Initial cost savings
- Such wide sidewalks not needed
- Reduces bridge weight and therefore reduces girder section
- Simpler design and construction

Loss of an amenity

DISCUSSION:

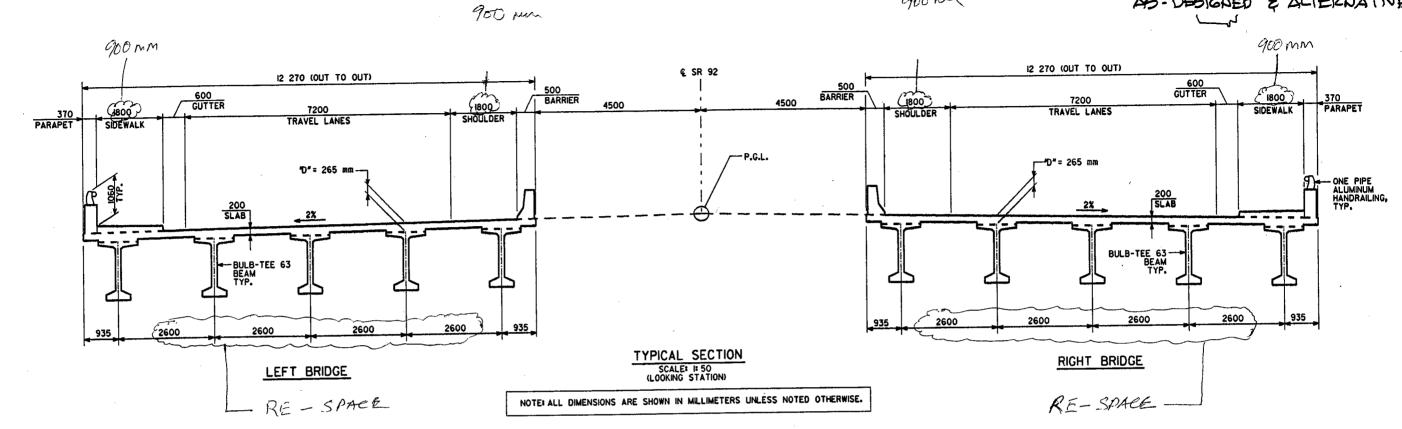
Reducing the sidewalk widths by half saves on concrete costs. The weight/load distribution of the girders is considerably reduced, thereby reducing girder cross section/strand requirements.

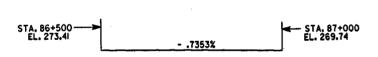
COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	5,635,239	3/4	\$	5,635,239
ALTERNATIVE	\$	4,808,558	3/4	\$	4,808,558
SAVINGS	\$	826,681	3/4	\$	826,681

SHEET 2044

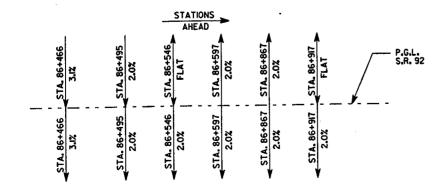
900 mg

AG-DESIGNED & ALTERNATIVE





PROPOSED GRADE DATA



SUPERELEVATION TRANSITION DATA

	DRAINAGE D	ATA ***	
DRA	AINAGE AREA = 198		
FLOOD FREQUENCY	DISCHARGE *	AREA **	MEAN VELOCITY
50-YEAR	132.30 m³/S	171.68 m²	0.77 m/S
100-YEAR	151.82 m²/S	182.74 m²	0.83 m/S
500-YEAR	180.91 m ³ /S	202.62 m²	0.89 m/S

- ** THROUGH THE BRIDGE

 *** AREA OF THE OPENING BELOW HIGH WATER (m²)

 **** AREAS AND MEAN VELOCITIES CORRESPOND TO ANALYSIS

 CASE 3 WHERE CLARK CREEK CONTROLS THE FLOW.

THE	ORETI	CAL SO	COUR	EPTH	S (m)		
BENT	100	YEAR ST	TORM:	500	YEAR STORM		
LOCATION	GEN.	LOCAL	TOTAL	GEN.	LOCAL	TOTAL	
BENT 2	0.691	0.000	0.69i	1.042	0.000	1,042	
BENT 3	0.691	0.000	0.691	I.042	0.000	1.042	
BENT 4	0.691	0.000	0.691	L042	0.000	I.042	
BENT 5	0.691	0.000	0.691	1,042	0.000	1,042	
BENT 6	0.691	0.988	1.679	1.042	0.945	1.987	
BENT 7	0.691	1.030	1.721	1.042	0.978	2.020	
BENT 8	0.691	0.899	1.590	L042	L164	2.206	
BENT 9	0.691	0.939	1.630	1.042	L247	2.289	
BENT IO	0.69i	0.960	1.651	L042	1,271	2.313	
BENT II	0.691	0.975	1.666	L042	L286	2.328	

EACH BRIDGE CONSISTS OF:

H- 3L6 m PSC BEAM SPANS	SPECIAL	DESIG
2 - PILE END BENTS	SPECIAL	DESIG
IO - CONCRETE INTERMEDIATE BENTS	SPECIAL	DESIG

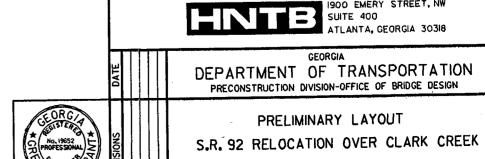
DESIGN DATA:

SPECIFICATIONS	A	ASHTO 1996
TYPICAL MSI8-44	AND/OR MILITARY LOADING	- IMPACT ALLOWE
FUTURE WEARING	SURFACE	- 0.72 KN/M²

TRAFFIC DATA:

TRAFFIC	ADT ADT	z	10,500 17,850	(2000) (2020)
DESIGN SPEED	· 70 - 4	KN %	A/HR	

BRIDGE NO. I LEFT & RIGHT P.I. NO. 620492



CHEROKEE COUNTY

NH-165-1(42)

SCALE: AS SHOWN

NOVEMBER 1999

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-11 (42)

DESCRIPTION:

SHEET NO .: 3 of 4

Reduced width of bridge = 12.27-2×0.9 = 10.47 M (Per Bridge)

Total Reduced Area of Both Bridges = 2x 10.47 x 347.6

= 7.278.75 m²

PRORATED BRIDGE COST:

COST OF ORIGINAL DESIGN = \$5,049,950 2x 347.6 x 12.27

2 \$ 592 /M2

COST OF ALTERNATIVE = 7278,75 × 592

z \$4,309,020

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-11 (42)

CONSTRUCTION ITEM		0	RIGINAL EST	IMATE	PR	OPOSED ESTI	MATE	
ITEN	1	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge		m ²	8,530.10	592.02	5,049,950	7,278.75	592.02	4,309,130
	Sub-total				5,049,950			4,309,130
Mark-up at	11.59%				585,289			4,309,130
	TOTAL				5,635,239			4,808,558



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-17 (42)

SHEET NO.: 1 of 4

DESCRIPTION: USE AASHTO TYPE IV GIRDERS IN LIEU OF BULB-TEE 63

BEAMS

ORIGINAL DESIGN: (Sketch attached)

The current design calls for the use of Bulb-Tee 63 beams for the bridge girders.

ALTERNATIVE: (Sketch attached)

Use AASHTO Type-IV girders in lieu of Bulb-Tee 63 beams.

ADVANTAGES:

DISADVANTAGES:

- Reduces initial cost
- Common practice

None apparent

DISCUSSION:

Type-IV girders can span the required 31.6 meters and are less costly than the proposed Bulb-Tee beams.

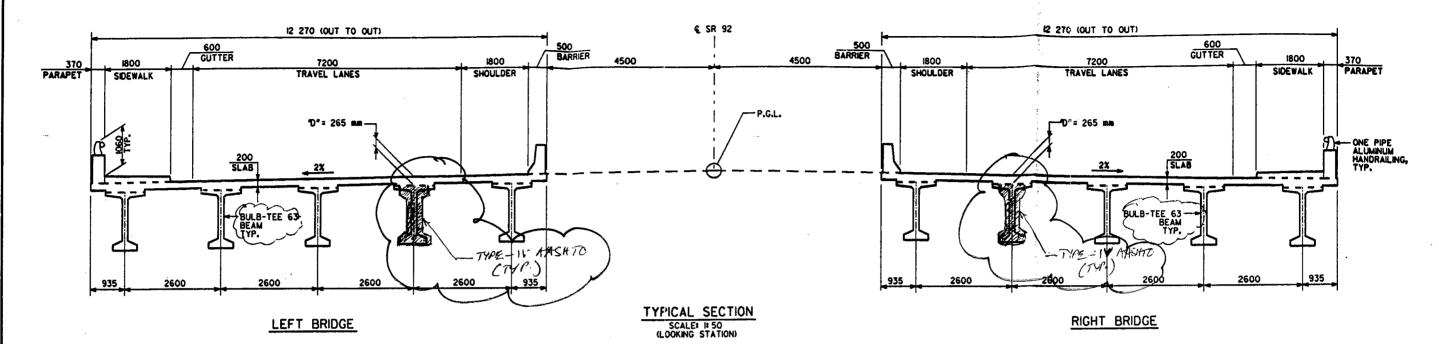
Due to the small amount of savings, this alternative should only be considered as a cost reduction effort. However, a more detailed investigation should be carried out to determine if AASHTO Type-III girders could be used to further reduce the cost impact of these structural members.

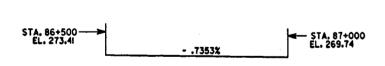
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	RESENT WORTH IFE-CYCLE COST
ORIGINAL DESIGN	\$ 1,756,196	3/4	\$ 1,756,196
ALTERNATIVE	\$ 1,737,733	3/4	\$ 1,737,733
SAVINGS	\$ 18,463	3/4	\$ 18,463

B-17 (42)

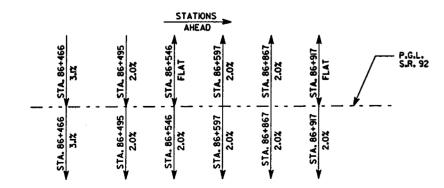
HET 2044

AS-DESIGNED & AUTERNATIVE





PROPOSED GRADE DATA



SUPERELEVATION TRANSITION DATA

	DRAINAGE D	ATA ***	
DR	AINAGE AREA = 198	ILOI HECTARES	
FLOOD FREQUENCY	DISCHARGE *	AREA **	MEAN VELOCITY
50-YEAR	132.30 m³/S	171.68 m²	0.77 m/S
100-YEAR	15L82 m³/S	182.74 m²	0.83 m/S
500-YEAR	180.91 m 3/S	202.62 m²	0.89 m/S

NOTE: ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS NOTED OTHERWISE.

LEGEND:

- # THROUGH THE BRIDGE
- ** AREA OF THE OPENING BELOW HIGH WATER (m2)
- **** AREAS AND MEAN VELOCITIES CORRESPOND TO ANALYSIS CASE 3 WHERE CLARK CREEK CONTROLS THE FLOW.

THEORETICAL SCOUR DEPTHS (m)									
BENT	100	YEAR S	TORM	500	YEAR ST	ORM			
LOCATION	GEN.	LOCAL	TOTAL	GEN.	LOCAL	TOTAL			
BENT 2	0.69	0.000	0.69	L042	0.000	1,042			
BENT 3	0.691	0.000	0.691	L042	0.000	L042			
BENT 4	0.69	0.000	0.691	L042	0.000	1.042			
BENT 5	0.691	0.000	0.691	L042	0.000	L042			
BENT 6	0.691	0.988	L679	L042	0.945	I , 987			
BENT 7	0.69	L030	L721	L042	0.978	2.020			
BENT 8	0.691	0.899	i.590	L042	LI64	2.206			
BENT 9	0.69i	0.939	1.630	L042	L247	2.289			
BENT IO	0.694	0.960	L65I	L042	L271	2.313			
BENT II	0.691	0.975	1,666	L042	L286	2.328			

EACH BRIDGE CONSISTS OF:

# - 3LE m PSC BEAM SPANS	SPECIAL	DESIGN
2 - PILE END BENTS		
10 - CONCRETE INTERMEDIATE BENTS	SPECIAL	DESIGN

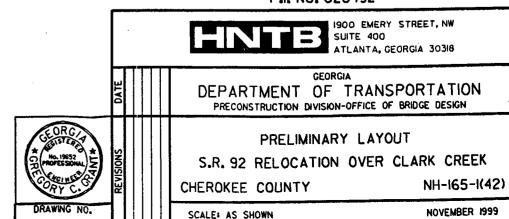
DESIGN DATA:

SPECIFICATIONS		AAS	HTO 1996
TYPICAL MSI8-44	AND/OR MILITARY LOA	DING 1	MPACT ALLOW
FUTURE WEARING	SURFACE	().72 KN/M2

TRAFFIC DATA:

TRAFFIC			10,500	
DESIGN SPEED			•	1202
24 HR TRUCKS	- 4	×		

BRIDGE NO. 1 LEFT & RIGHT P.I. NO. 620492



CALCULATIONS

PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-17(42)

SHEET NO .: 3 of 4

DESCRIPTION:

LENGTH OF BRIDGE = 347.6 MIS

No. OF SPANS = 11

LENGTH OF SPAN = 31.6 M

No. OF GIRDERS/SPAN/BRIDGE = 5

FOTAL LENGTH OF GIRDERS = 11 X31.6 X 5 X 2 [FOR BOTH BRIDLES]

= 3476 MTS

COST OF BTBGIRDER = \$ 452.76 /M

COST OF ASSHTO T-IV = \$ 448.00

(OST OF AASHTO T- 1 (HIC) = \$ 297.16

SAMNUS WITH T-IV 160 87-63 = (452.76-448.00) X 3476

= \$ 16,545.76

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

B-17 (42)

CONSTRUCTION ITEM		0	RIGINAL EST	IMATE	PROPOSED ESTIMATE			
ITEN	Л	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bulb-Tee 63 Beams		lm	3,476	452.76	1,573,794			
AASHTO Type-IV (Girder	lm				3,476	448.00	1,557,248
	Sub-total				1,573,794			1,557,248
Mark-up at	11.59%				182,403			180,485
	TOTAL				1,756,196			1,737,733



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-4(42)

SHEET NO.: 1 of 4

DESCRIPTION: USE A ONE-WAY PAIR SOLUTION WITH EXISTING

CULVERT AND A NEW TWO-LANE BRIDGE

ORIGINAL DESIGN: (Sketch attached)

The current design calls for a symmetrical alignment throughout the length of the project requiring abandonment of the existing two-lane culvert spanning Clark Creek and construction of two, 2-lane bridges on a new alignment over Clark Creek.

ALTERNATIVE: (Sketch attached)

Retain the existing Clark Creek crossing and current alignment of Hunt Road/Jacob Road and the Old SR 92/Kellog Creek Road as a westbound, one-way, 2-lane roadway. Realign the new eastbound SR 92 as a one-way, 2-lane roadway and construct a new 2-lane bridge over Cark Creek. Join the existing and new SR 92 just west of Old Alabama Road.

ADVANTAGES:

- Takes advantage of an existing asset
- Improves constructibility
- Lower initial costs
- Easier to maintain traffic during construction

DISADVANTAGES:

- Creates a one-way pair in an urban setting
- Does not initially meet driver expectation

DISCUSSION:

This alternative maintains the existing SR 92 roadway as the westbound roadway and provides for a new two-lane roadway on the current proposed new alignment for eastbound traffic, creating a one-way pair in the vicinity of the Clark Creek crossing. The big savings and benefits with this alternative include reduced right-of-way costs, elimination of one bridge structure, reduced environmental impacts, and salvation of some of the existing roadway. Some upgrades to the existing roadway will be required.

It is noted that right-of-way costs need to be checked and upgraded to match current estimate.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$ 23,497,033	3/4	\$	23,497,033
ALTERNATIVE	\$ 15,143,865	3/4	\$	15,143,865
SAVINGS	\$ 8,353,168	3/4	\$	8,353,168



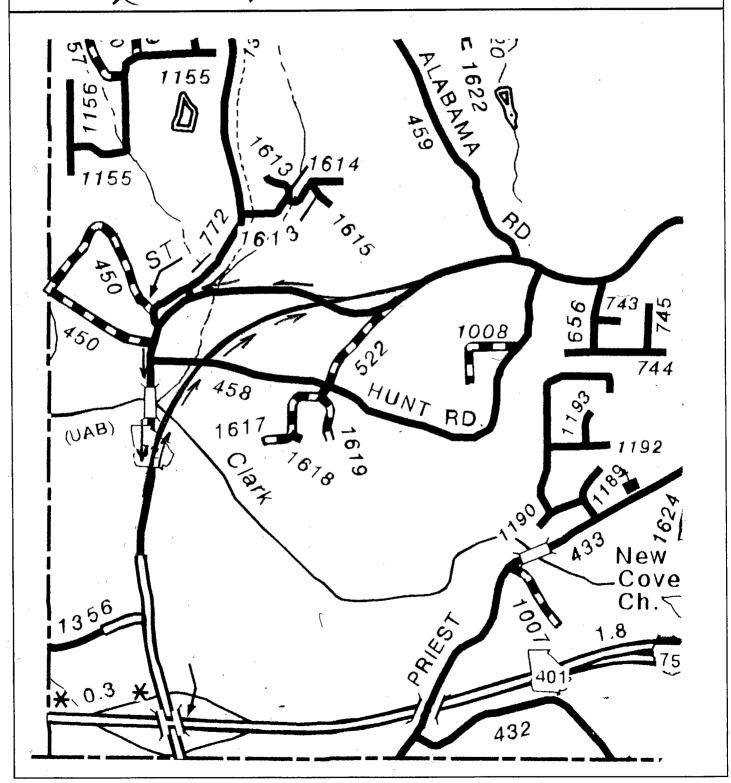
NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE

4-4 (4Z)

SHEET NO.: 2 of 4



CALCULATIONS

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-4(42)

DESCRIPTION:

SHEET NO .: 27 of 4

COST PER LM OF FULL WIDTH

POMOWAY IS ABOUT \$1700

FOR UNLY MALF/ONE POMOWAY USE \$800

BPRDAE COST \$ 5,000,000

FULL WIDTH / Z BPRDAE - 5,500,000

USE ONUI BRDAE - 7,500,000

R/W COSTS

TOTAL PLW LOSIS FOR THIS SERTION
WE'RE ABOUT # 12,000,000 PROJULE
TO ABOUT # 8,000,000 ATHOUGH
SOME OF THIS AWA IS A COE
PROPERTY

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-4(42)

CONSTRUCTION I	ORIGINAL ESTIMATE			PROPOSED ESTIMATE			
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
New roadway	lm	1,803	1,200.00	2,163,600	1,803	800.00	1,442,400
Additional westbound roadway	lm				600	800.00	480,000
Bridge	LS			5,049,950			2,524,975
Sı	ubtotal			7,213,550			4,447,375
Mark-up at 4	4.01%			3,174,683			1,957,290
Su	ubtotal			10,388,233			6,404,665
Right-of-way	LS			12,000,000			8,000,000
Mark-up at	9.24%			1,108,800			739,200
Su	ubtotal			13,108,800			8,739,200
<u> </u>							
Sub	o-total			23,497,033			15,143,865
Mark-up at				INCL			INCL
Т	OTAL			23,497,033			15,143,865



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-5(42)

DESCRIPTION: MAINTAIN HUNT ROAD ALIGNMENT

SHEET NO.: 1 of 4

ORIGINAL DESIGN: (Sketch attached)

Original design relocates Hunt Road from the new location of SR-92 to the old location of SR-92. This change aligns Hunt Road with Kellogg Creek Road and requires 300 meters of new roadway, a new culvert over the northeast tributary to Clark Creek, and three settlement basins for erosion control.

ALTERNATIVE: (Sketch attached)

Keep Hunt Road in its present location and eliminate the 300 meters of new roadway. An additional third lane should be added which will require an additional right-of-way as well as an extension of the existing culverts under Hunt Road.

If the Hunt Road to Kellogg Creek Road traffic counts justify additional work, the alignments from Hunt Road/SR-92 to Kellogg Creek can be reconfigured.

ADVANTAGES:

DISADVANTAGES:

- Lowers construction cost
- Avoids wetlands
- Reduces right-of-way costs

Retains Hunt Road to Kellogg Creek Road in its present configuration

DISCUSSION:

After SR-92 is relocated, Hunt Road becomes the main access to Jacobs Road, James Road, and Kellogg Creek Road. Since one half of the present eastbound SR-92 traffic exits onto one of these roads, Hunt Road must be improved but the relocation should be re-examined to use as much existing pavement as possible.

COST SUMMARY	ı	PRESENT WORTH RECURRING COSTS		PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	2,757,577	3/4	\$	2,757,577
ALTERNATIVE	\$	754,782	3/4	\$	754,782
SAVINGS	\$	2,002,795	3/4	\$	2,002,795

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

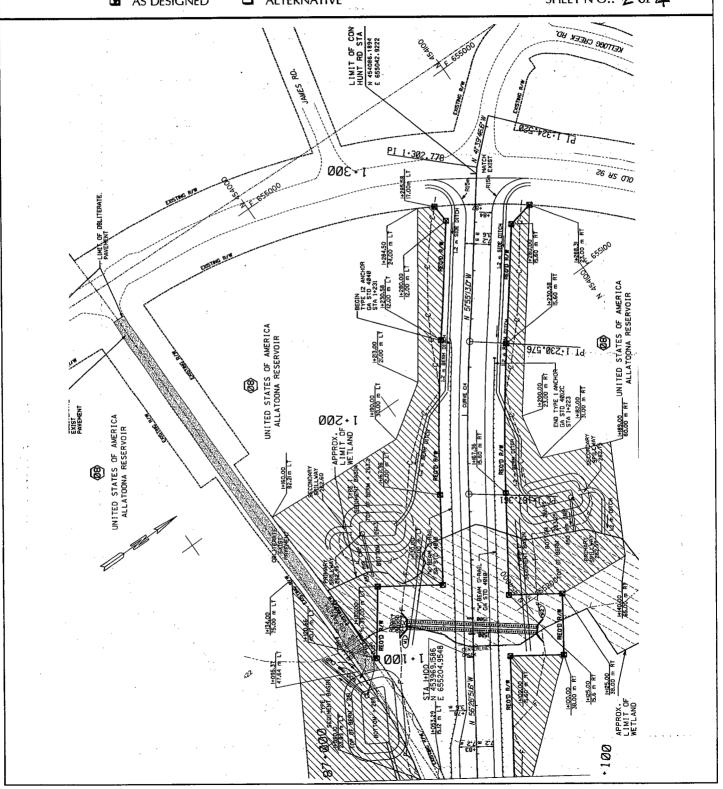
ALTERNATIVE NO.:

1.5 (AZ)

SHEET NO.: 2 of 4

✓ AS DESIGNED

■ ALTERNATIVE

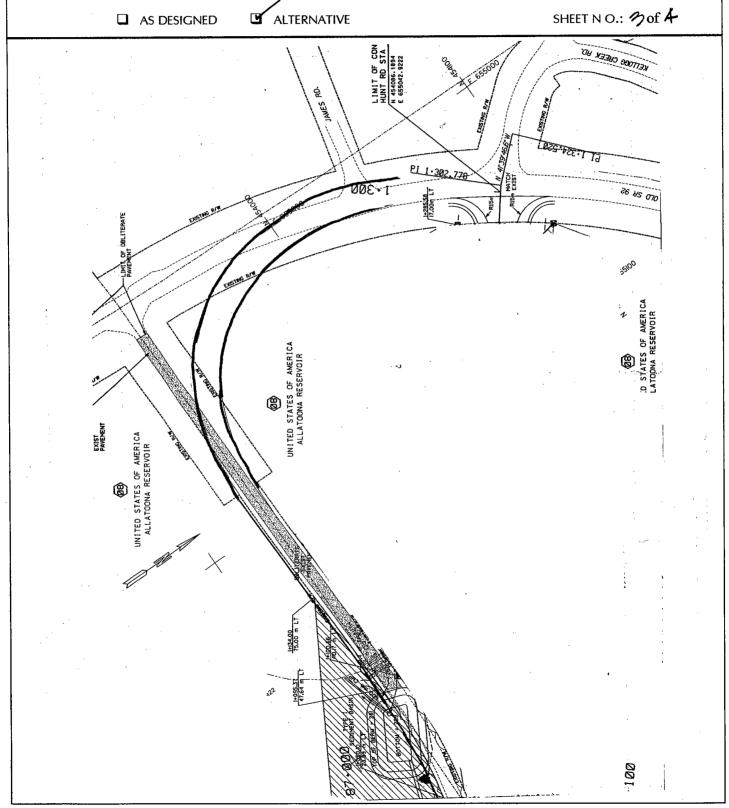


NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

4.5(42)



COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-5 (42)

CONSTRUCTION ITEM			C	ORIGINAL E	STIMATE	PROPOSED ESTIMATE		
	ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
New roadway		m^2	3,332	40.00	133,280	1,232	40.00	49,280
Culvert		lm	108	400.00	43,200	40	400.00	16,000
Pavement oblitera	ition	m^3	445	11.00	4,895		11.00	
Temporary Erosio	on Control	m	594	14.00	8,316	149		
Slope Protection		m^2	7,848	20.00	156,960	1,962		
Erosion Ditch Che	ecks and Protection							
	Silt fence	m	248	10.00	2,480	62	10.00	620
	Maintenance	m	248	4.00	992	62	4.00	248
	Perm Soil Rein mtl	m	718	10.00	7,180	180	10.00	1,795
	Maint	m	718	10.00	7,180	180	10.00	1,795
	Std Dumped Rip Rap	m^2	428	22.00	9,416	107	22.00	2,354
	ST Blanket	m^2	480	4.00	1,920	120	4.00	480
	Maintenance	m^2	480	1.00	480	120	1.00	120
Guard Rail		m	600	30.00	18,000			
					394,299			72,692
	Mark-up at 44.01%				173,531			31,992
	Subtotal				567,830			104,684
	7,748,000 / (6,838m x	m ²	10,105	198.37	2,004,529	3,000	198.37	595,110
35.2m) = \$198.3	$(7/\text{m}^2)$							
	Mark-up at 9.24%				185,218			54,988
	Subtotal				2,189,747			650,098
	21				2.77.77			754 502
	Sub-total				2,757,577			754,782
Mark-up at					INCL			INCL
	TOTAL				2,757,577			754,782



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-8(42)

SHEET NO.: 1 of 4

DESCRIPTION: ELIMINATE JAMES DUPREE LANE ACCESS TO SR 92 AND

RECONNECT TO RELOCATED LITTLE RIDGE ROAD

ORIGINAL DESIGN: (Sketch attached)

The current design calls for a symmetrical alignment throughout the length of the project with new crossings, left-turn lanes, and improved accessibility. The new work includes direct access of James Dupree Lane onto SR 92 to accommodate truck traffic associated with a mulching operation just north on James Dupree Lane. To minimize congestion and eliminate an intersection/turning lane, Little Ridge Road access to SR 92 was realigned further east along SR 92.

ALTERNATIVE: (Sketch attached)

Eliminate the James Dupree Lane access to SR 92 and connect to the relocated Little Ridge Road.

ADVANTAGES:

- Improves safety on SR 92
- Accommodates mulching operation at an intersection rather than with turning movements

DISADVANTAGES:

- Loss of direct access onto SR 92 from James Dupree Lane
- Higher costs due to new connector

DISCUSSION:

While acknowledging a cost increase to the project, this alternative provides a much safer, more convenient alignment for the trucking operation associated with the mulching plant. Rather than providing an additional median break on SR 92 where numerous openings are already planned, reroute the traffic to the relocated Little Ridge Road alignment where the truck traffic can then use the new proposed intersection of Little Ridge Road and SR 92.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS		PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	0	3/4	\$	0	
ALTERNATIVE	\$	883,805	3/4	\$	883,805	
SAVINGS	\$	(883,805)	3/4	\$	(883,805)	

SKETCHES



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

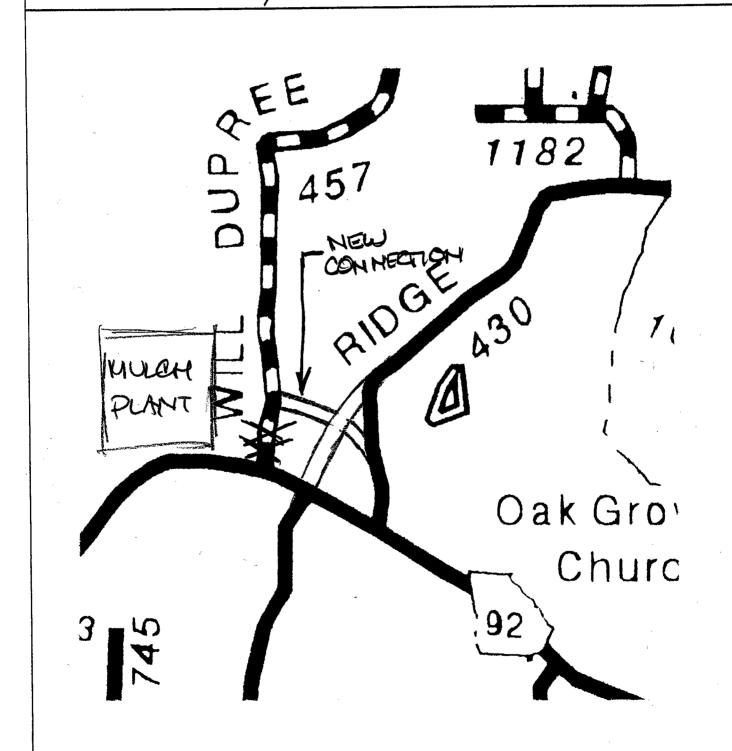
Final Design Development

☐ AS DESIGNED

AŁTERNATIVE

ALTERNATIVE NO.:

SHEET NO.: 2 of 4



CALCULATIONS

PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.: \

DESCRIPTION:

SHEET NO.: 3 of4

MINOR POADURY CONSTRUCTION COST SAINGS & JAMES DIPROF LANT / HERVISIBLE

NEW POAPWAY WUSTWURDY

Z LANE TROM TO INTERSECTION OF

RELOCATED LITTLE PROGE POWD AD

OLD LITTLE PLOGE POWD - ABOUT

180 METERS

ASSUME COST OF ABOUT 400 LM

P/W: $180m \times 20m = 3600 m^2$ (SEE ALT. A-5(42) FOR DERNATION OF UNIT COST FOR m^2 of P/W @ \$ 198.37 (m^2)

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-8(42)

CONSTRUCTION ITEM		C	RIGINAL ES	STIMATE	PROPOSED ESTIMATE			
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
New side road construction	lm				180	400.00	72,000	
Mark-up at 44.019	%						31,687	
Subtota	al						103,687	
Right-of-way	m ²				3,600	198.37	714,132	
Mark-up at 9.249	%						65,986	
Subtota	al						780,118	
Sub-tota	al						883,805	
Mark-up at							INCL	
TOTA	1						883,805	



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-10(42)

SHEET NO.: 1 of 4

DESCRIPTION: SHIFT PROPOSED ALIGNMENT TO REUSE/RESURFACE

EXISTING ROADWAY

ORIGINAL DESIGN: (Sketch attached)

The current design calls for a symmetrical alignment throughout the length of the project.

ALTERNATIVE: (Sketch attached)

Shift the proposed alignment to reuse/resurface the existing roadway.

ADVANTAGES:

- Takes advantage of an existing asset
- Improves constructibility
- Lowers initial costs

DISADVANTAGES:

- Possible asymmetrical widening
- Aesthetics

DISCUSSION:

In some areas, especially where the current roadway is adequate and in existing alignment areas, this alternative would shift the alignment to take advantage of the existing asset and reuse the existing roadway. Rather than constructing full-depth pavement, only resurface the existing roadway thereby saving construction costs. The right-of-way implications will be more severe on the shifted side but much less on impacts on the non-shifted side with a possible savings that could not be calculated at this time. Within the built-up commercial areas, this will have to be investigated closely.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	641,565	3/4	\$	641,565
ALTERNATIVE	\$	0	3/4	\$	0
SAVINGS	\$	641,565	3/4	\$	641,565

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

☐ AS DESIGNED ☐ ALTERNATIVE

ALTERNATIVE NO.:

A-10 (42)

SHEET NO.: 2 of 4

MB RUAD

EB RUAD

ERISTING >

AS DBIGNED

ALTERNATIVE

-POADWAY SHIFT CAN VARY

WB ROAD

EB RUAD

CALCULATIONS _



PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE, NO.:

A-10 (42)

DESCRIPTION: SHEET NO.: 3 of 4

COST SAVINGS WILL BE COST OF FULL DODTH PARMONT VS OVERLAY-PER LINEAR METER

B) ASP. CONC. 120
7,2 H WIDE

B) GAB, 150 MM

1 () ()

SA4 25 \$/M2 x 7,2 MWIDE = 1807LM

FROM STA 89+500 = 92+800 ASSUME 75% OF THIS SERTIN OF PROJECT 92800 - 89500 = 3300 x 75%

2475 METERS

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-10 (42)

CONSTRUCTION ITEM		C	RIGINAL E	STIMATE	PROPOSED ESTIMATE			
ITE	M	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
oadway		lm	2,475	180.00	445,500			
,								
	Sub-total				445,500			
Mark-up at	44.01%				196,065			
	TOTAL				641,565			



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-14(42)

DESCRIPTION: REALIGN WESTERN PORTION OF PROJECT 42

SHEET NO.: $1\ of\ 5$

ORIGINAL DESIGN: (Sketch attached)

The current design follows the proposed new alignment to the south and east of the existing SR 92 alignment.

ALTERNATIVE: (Sketch attached)

Shift the proposed alignment of the western portion of the project further south and east. Tie back into the proposed new alignment in the vicinity of Plantation Road at approximately STA 87+800±.

ADVANTAGES:

- Shorter/more direct alignment
- Creek crossing further upstream should permit a shorter bridge
- Reduces environmental and wetland impacts

DISADVANTAGES:

- Further away from existing SR 92 alignment
- Will require re-design, further permitting, additional mapping and coverage

DISCUSSION:

This alternative would shorten the alignment by 320 meters from STA 85+950 to STA 88+100 thereby reducing construction costs, right-of-way, costs and environmental impacts.

Since the bridge will be further upstream, there should be fewer environmental impacts and the bridge can also be shortened. A 15% reduction was assumed for the cost savings calculations; however, it could be greater.

Although further away from the existing SR 92 alignment, only one minor road will require connecting and, while a new bridge will have to be designed, these inconveniences are off-set by the right-of-way cost savings.

It is noted that some of the costs from the estimate provided appear to be dated for the level of design completion. As such they should be reviewed and adjusted accordingly. This is especially true in the right-of-way costs noted for this project.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	23,428,758	3/4	\$	23,428,758
ALTERNATIVE	\$	19,918,678	3/4	\$	19,918,678
SAVINGS	\$	3,510,080	3/4	\$	3,510,080

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

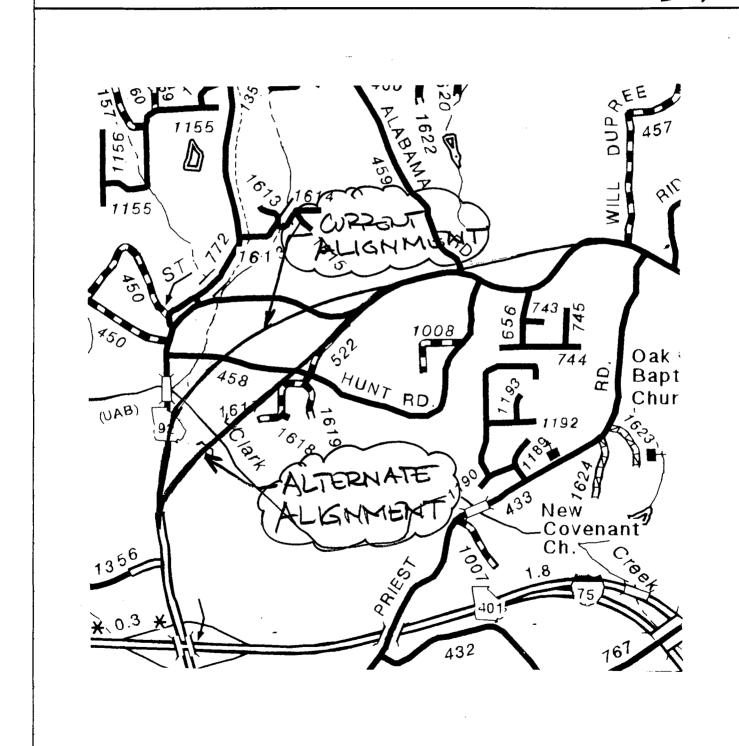
ALTERNATIVE NO.:

A-14(42)

SHEET NO .: 2 of 5

AS DESIGNED

ALTERNATIVE



CALCULATIONS



PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-14(42)

DESCRIPTION:

SHEET NO .: 3 of 5

COST PER LINEAR METER OF FULL WIDTH POADURY - NEW ALKHHONT 10 (7.2 +0.6) Z + 50 /H2 WES: GUTTER (1) Z + 35 /LM 1,525 (2) x 28 /m2 COL SIREWALK 25 200 GRADING/DRAINAGE/MISC ASSUME

EXISTING BRIDGE - COST

BRIDGE UST > 5,000,000 + 2(1138) 40.25 = 5A.6

CALCULATIONS



PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-14(42)

DESCRIPTION:

SHEET NO.: 4 of 5

ORGINAL PROPOSED ALIGNMENT-

STA 85+950 -> 38+100 = 2150 H

TOTAL WHATH = 2150 M

MI WHATH = 1830 M

320 H SHOWER > 15%

TOTAL LINGTH OF

PURDURY - OPIGINAZ ALIGNMENT

2150 - 347 = 1803 M

ADERLATE THRONT - ASSUME 15% REDUCTION

347 (0.85) = Z95 M

1830 - 295 = 1535M

PAHT OF WAY COSTS - TOTAL PROJECT LENGTH. 6838M

PORTION OF PROJECT - 2150 = 31.4%

ASSUME, SINCE THIS IS MORE PURAL SERTION OF PROJECT THIS ALIGNMENT CONSTITUTES 25% OF

W/A LESCOND WILL

\$ 47,750,000 x 0.25-\$ 11,937,500

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-14 (42)

DESCRIPTION: SHEET NO. 5 of 5

CON	ISTRUCTION ITEM		C	ORIGINAL E	STIMATE	PROPOSED ESTIMATE			
רו	EM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
New roadway		lm	1,803	1,200.00	2,163,600	1,535	1,200.00	1,842,000	
Bridge		ls	1		5,049,950	1		4,292,458	
	Subtotal				7,213,550			6,134,458	
	Mark-up at 44.01%				3,174,683			2,699,775	
	Subtotal				10,388,233			8,834,232	
Right of way		ls	1		11,937,500	1		10,146,875	
	Mark-up at 9.24%				1,103,025			937,571	
	Subtotal				13,040,525			11,084,446	
	Sub-total				23,428,758			19,918,678	
Mark-up at					INCL			INCL	
	TOTAL				23,428,758			19,918,678	



PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-1(42)

DESCRIPTION: REDUCE MEDIAN WIDTH TO 6.1 METERS

SHEET NO.: 1 of 4

ORIGINAL DESIGN: (Sketch attached)

The current design calls for the use of a 13.6 m wide median throughout the majority of the project length.

ALTERNATIVE: (Sketch attached)

Reduce the median width from 13.6m to 6.1m.

ADVANTAGES:

- Reduces initial cost
- Reduces right-of-way purchases
- Reduces right-of-way impacts
- Common practice

DISADVANTAGES:

- More difficult to expand in the future
- Does not agree with current widening project philosophies

DISCUSSION:

Reduce the median to 6.1m to accommodate the current and immediate future need rather than the proposed 13.6m for unknown future expansion. The instant project is, in fact, the needed widening for the immediate future and there are no guarantees that continued expansion will occur beyond the projected demographics along this corridor of SR 92.

Although initial construction costs are reduced, the bulk of the savings is derived from a reduction in the amount of right-of-way needed and its associated impacts.

Consideration could be given to implementing this alternative at specific portions where known growth is immediately needed but not for the entire 6.838 kilometer length of the project.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	54,722,093	3/4	\$	54,722,093
ALTERNATIVE	\$	42,625,595	3/4	\$	42,625,595
SAVINGS	\$	12,096,498	3/4	\$	12,096,498

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

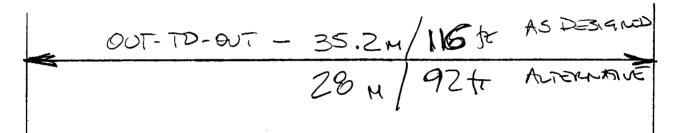
ALTERNATIVE NO.:

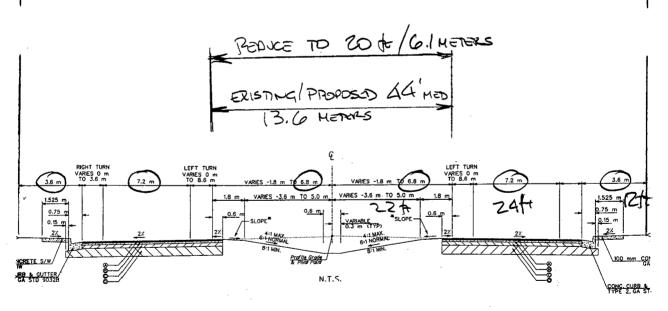
R-1 (42)

AS DESIGNED

☐ ALTERNATIVE

SHEET N O .: 2 of 4





CALCULATIONS

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO .:

R-1 (42)

DESCRIPTION:

SHEET NO .: 3 of 4

PEDUCE MEDIAN WIDTH TO 20 JE, PEDUCE BY 24 FOET.

REDUCE FROM OVERAL OUT-TO-OUT DIMONSIONS

35. 2 m/ 116 t= > 28 m/92 te

20% Rasian

R/W COSTS - REDUCED BY 20%

THERE DILL BE SOME ROUGHOU IN ROADWAY
CONSTRUCTON COSTS - EARTH WORK (DRANKE)
GRADING, HOWEVER MESE VILL BE
PERATURY MINOR, COMPAND TO RIW COSTS
ASSUME ABOUT \$1,000,000

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-1(42)

DESCRIPTION: SHEET NO. 4 of 4

CONSTRUCTION ITEM			C	ORIGINAL I	ESTIMATE	PROPOSED ESTIMATE			
ITEM		UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
R/W Costs									
M/U	J @ 11.59%	LS	1		47,748,000			38,198,400	
					5,533,993			4,427,195	
Roadwork Construction	on	LS	1		1,000,000				
	J @ 44.01%				440,100				
	Sub-total				54,722,093			42,625,595	
Mark-up at					Included			Included	
	TOTAL				54,722,093			42,625,595	



PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-2(42)

DESCRIPTION: REDUCE MEDIAN WIDTH TO 1.8 METERS

SHEET NO.: 1 of 4

ORIGINAL DESIGN:

The current design calls for the use of a 13.6 m wide median throughout the majority of the project length.

ALTERNATIVE: (Sketch attached)

Reduce the median width from 13.6m to 1.8m.

ADVANTAGES:

- Reduces initial cost
- Reduces right-of-way purchases
- Reduces right-of-way impacts
- Common practice in high-cost ROW areas

DISADVANTAGES:

- More difficult to expand in the future
- Does not agree with current widening project philosophies
- Requires transitions at side roads for left turn lanes

DISCUSSION:

Reduce the median to 1.8m with a center concrete barrier to accommodate the current and immediate future need rather then the proposed 13.6m for unknown future expansion. The instant project is, in fact, the needed widening for the immediate future, and there are no guarantees that continued expansion will occur beyond the projected demographics along this corridor of SR 92.

Although initial construction costs are reduced, the bulk of the savings is derived from a reduction in the amount of right-of-way needed and its associated impacts.

While this alternative would introduce a physical barrier and require transitions at the side streets for turn lanes, it would significantly reduce the overall width of the project and needed right-of-way purchases, impacts and costs.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	55,442,143	3/4	\$	55,442,143
ALTERNATIVE	\$	43,699,995	3/4	\$	43,699,995
SAVINGS	\$	11,742,148	3/4	\$	11,742,148

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

☐ AS DESIGNED

ALTERNATIVE

ALTERNATIVE NO.:

F-2(42)

SHEET N O .: 2 of 4

TRAPELANGE LANGES

1.8 M

CALCULATIONS

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO .:

R-2(42)

SHEET NO .: 3 of 4

DESCRIPTION:

25,2 m/16 to 70 23,4/76 to

24% REDUCTION HOWERTH, WE WILL
HERS TO WIDEN @ SIDE STRONGS FOR
LEFT TURN LANGS - USE 25% REDUCTION

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-2(42)

DESCRIPTION: SHEET NO. 4 of 4

CONSTRUCTION I	ТЕМ	(ORIGINAL E	ESTIMATE	PROPOSED ESTIMATE			
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
R/W Costs								
M/U @ 11.59%	LS	1		47,748,000			35,811,000	
				5,533,993			4,150,495	
Roadwork Construction	LS	1		1,500,000				
M/U @ 44.01%	,)			660,150				
New Concrete Barrier								
M/U @ 44.01	M				6,490	400.00	2,596,000	
							1,142,500	
Sub	o-total			55,442,143			43,699,995	
Mark-up at				Included			Included	
T	OTAL			55,442,143			43,699,995	



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-6(42)

DESCRIPTION: ELIMINATE SIDEWALKS FROM NORTHPOINT PARKWAY

TO WOODLAND DRIVE

SHEET NO.: 1 of 2

ORIGINAL DESIGN:

The current design calls for the use of sidewalks on both sides of SR-92.

ALTERNATIVE:

Eliminate sidewalks in their entirety from the project.

ADVANTAGES:

- Lowers initial costs
- Improves constructibility
- Easier to construct
- Common practice for like applications

DISADVANTAGES:

- Not pedestrian friendly throughout the project
- Does not promote pedestrian traffic
- Not in keeping with GDOT direction

DISCUSSION:

This section of SR-92, though classified as urban, does not currently have and is not anticipated to have any pedestrian traffic due to the nature of the commercial businesses along this portion of the corridor. Although the loss of sidewalks does not promote pedestrian traffic, expenditure of dollars for a facility structure that will not be used is inappropriate and the funds could be better allocated for other uses.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	700,969	3/4	\$	700,969
ALTERNATIVE	\$	0	3/4	\$	0
SAVINGS	\$	700,969	3/4	\$	700,969

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-6 (42)

DESCRIPTION: SHEET NO. 2 of 2

CONS	TRUCTION ITEM		C	RIGINAL ES	TIMATE	PROPOSED ESTIMATE			
ITE	М	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
dewalks		m^2	19,470	25.00	486,750				
	Sub-total				486,750				
Mark-up at	44.01%				214,219				
	TOTAL				700,969				



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-7(42)

DESCRIPTION: DO NOT OBLITERATE PAVEMENT

SHEET NO.: 1 of 2

ORIGINAL DESIGN:

The original plans call for obliteration of the abandoned pavement of roads being relocated.

ALTERNATIVE:

Leave the abandoned pavement in place and do not obliterate and haul off the excess material.

ADVANTAGES:

- Lowers initial project cost
- Slightly reduces construction time
- Precludes hauling operation

DISADVANTAGES:

- Reduces aesthetics
- Could be perceived as a traffic mis-direction
- Impervious surface remains in place; not environmentally friendly
- Invites loitering; an attractive nuisance

DISCUSSION:

Eliminating obliteration operation of the abandoned roads should be undertaken only as a cost reduction effort. Leaving abandoned pavement in situ is not environmentally friendly and becomes an attractive nuisance and carries an undesirable liability.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	76,925	3/4	\$	76,925
ALTERNATIVE	\$	0	3/4	\$	0
SAVINGS	\$	76,925	3/4	\$	76,925

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-7(42)

DESCRIPTION: SHEET NO. 2 of 2

CONSTRUCTION ITEM			C	RIGINAL E	STIMATE	PROPOSED ESTIMATE			
ITE	M	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
avement Obliteration	on	m^3	2,671	10.00	26,707				
Iaul and landfill		m^3	2,671	10.00	26,710				
	Sub-total				53,417				
Mark up at							-		
Mark-up at	44.01%				23,509		-		
	TOTAL				76,925				



PROJECT: SR 92 WIDENING

ORIGINAL DESIGN:

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-12(42)

SHEET NO.: 1 of 4

DESCRIPTION: USE A FIVE LANE SECTION FOR WIDENING

The current design calls for the use of a 13.6 m wide median throughout the majority of the project length that allows for two-lane traffic in both directions, dedicated left turning lanes, and a median of sufficient width to accommodate a future drive lane for both directions.

ALTERNATIVE: (Sketch attached)

Reduce the median width from 13.6m to 4.3m and provide a fifth turning lane in the median.

ADVANTAGES:

- Reduces initial cost
- Reduces right-of-way purchases
- Reduces right-of-way impacts
- Common practice in high-cost ROW areas

DISADVANTAGES:

- More difficult to expand in the future
- Not in agreement with current widening project philosophies
- Some safety reduction

DISCUSSION:

This alternative would allow for a reduced typical section thereby reducing construction costs and right-of-way costs. A median would not be included and the design speed would have to be reduced. However, due to the highly commercialized nature of the area and this rapidly growing section of the SR 92 corridor, this is feasible, at least for some portions of the project, at the eastern end closer to Interstate 75.

The savings noted is for a fifth lane to run the entire length of the project at 6.838 kilometers.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	53,281,993	3/4	\$	53,281,993
ALTERNATIVE	\$	39,428,675	3/4	\$	39,428,675
SAVINGS	\$	13,853,318	3/4	\$	13,853,318

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

☐ AS DESIGNED

ALTERNATIVE

ALTERNATIVE NO.:

R-12(42)

SHEET N O .: 2 of 4

ARTHME

JK

7.2 +4.3 + 7.2 +3.6

OUT-TO-OUT 25.9 M/85te C+70 REDIGHT HEDIAN FROM 44 to TO

PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

, ALTERNATIVE NO.:

R-12 (42)

DESCRIPTION:

SHEET NO.: 3 of 4

Overtu redución is from 35,2m/116/t 10 25,9m/85/te - 76% redución.

CONSTIUDING COST ASSUME EQUINS OUT -

AAt GRASSO MEDIAN IS EQUIVARENT TO

15 BPHAT PARMOUT

COST SAVINGS IS IN P/W

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-12 (42)

DESCRIPTION: SHEET NO. 4 of 4

CONS	TRUCTION ITEM		C	RIGINAL ES	STIMATE	PROPOSED ESTIMATE			
ITE	M	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
W Costs		LS	1		47,748,000	1		35,333,520	
	Calcara				47.740.000			25.222.52	
Mark-up at	Sub-total				47,748,000 5,533,993			35,333,520	
iviai k-up at	11.59% TOTAL				53,281,993			4,095,155 39,428,675	
	IOTAL				33,401,993			37,420,073	



SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

PRESENT WORTH OF COST SAVINGS

		PRESEIVE WORTH OF COST SAVINGS									
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS					
	ALIGNMENT FOR PROJECT 40 (A-x (40))										
A-1 (40)	Shift proposed alignment to reuse/resurface existing roadway	\$615,617	\$0	\$615,617		\$615,617					
A-5 (40)	Eliminate median break at Quail Run (STA 95+373)	\$134,924	\$0	\$134,924		\$134,924					
A-8 (40)	Eliminate median break at STA 95+875	\$160,696	\$0	\$160,696		\$160,696					
	ROADWAY FOR PROJECT 40 (R-x (40))										
R-1 (40)	Reduce median width to 6.1 meters	\$15,528,820	\$10,967,696	\$4,561,124		\$4,561,124					
R-2 (40)	Reduce median width to 1.8 meters	\$16,135,220	\$12,596,817	\$3,538,403		\$3,538,403					
R-4 (40)	Eliminate sidewalks from Woodland Drive to Cherokee Trail	\$433,879	\$0	\$433,879		\$433,879					
R-5 (40)	Do not obliterate pavement	\$17,788	\$0	\$17,788		\$17,788					
R-10 (40)	Use a five-lane section for widening	\$13,709,620	\$10,145,119	\$3,564,501		\$3,564,501					
R-13 (40)	Reduce height of retaining walls and provide railing	\$1,432,620	\$1,106,074	\$326,546		\$326,546					
R-14 (40)	Use mechanically stabilized earth walls in lieu of gravity retaining walls	\$1,432,620	\$1,207,949	\$224,671		\$224,671					
R-16 (40)	Use keystone walls in lieu of gravity retaining walls	\$1,432,620	\$859,572	\$573,048		\$573,048					



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ORIGINAL DESIGN: (Sketch attached)

ALTERNATIVE NO.:

A-1(40)

SHEET NO.: 1 of 4

DESCRIPTION: SHIFT PROPOSED ALIGNMENT TO REUSE/RESURFACE

EXISTING ROADWAY

ZAISTING KOADWAT

The current design calls for a symmetrical alignment throughout the length of the project

ALTERNATIVE: (Sketch attached)

Shift the proposed alignment to reuse/resurface the existing roadway.

ADVANTAGES:

- Takes advantage of an existing asset
- Improves constructibility
- Lower initial costs

DISADVANTAGES:

- Possible asymmetrical widening
- Aesthetics

DISCUSSION:

In some areas, especially where the current roadway is adequate and in existing alignment areas, this alternative would shift the alignment to take advantage of the existing asset and reuse the existing roadway. Rather than constructing full-depth pavement, only resurface the existing roadway, thereby saving construction costs. The right-of-way implications will be more severe on the shifted side but much less severe. The possible savings could not be calculated at this time. Within the built-up commercial areas, this will have to be investigated closely.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	615,617	3/4	\$	615,617
ALTERNATIVE	\$	0	3/4	\$	0
SAVINGS	\$	615,617	3/4	\$	615,617

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

☑ AS DESIGNED

ALTERNATIVE

ALTERNATIVE NO.:

A-1 (40)

SHEET NO.: 2 of 4

WB RUND

EB RUMD

VIII MATERIAL IN PARTO

ERISTING >

AS DEGALED

ALTERNATIVE

-PUADWAY SHIPT CAN VARY

WB ROAD

EB RUAD

Mullille

CALCULATIONS

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-1 (40)

SHEET NO .: 3 of 4

DESCRIPTION:

COST SAVINGS WILL BE COST OF FULL DEDTM PARTMENT B OVERLAY-PER LINEAR METER

B) ASP. CONC, 120 C) ASP CONC, 240 D) GAB, 150 MM SMY 25 \$/M2 x 7,2 MWID= = 180

98800 => 97+500 - ASSUME 60% 97500-92800 - 4700 * 60%

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-1 (40)

DESCRIPTION: SHEET NO. 4 of 4

CONST	TRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE			
ITEN	М	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
oadway		lm	2,820	180.00	507,600				
	Sub-total				507,600				
Mark-up at	21.28%				108,017				
-	TOTAL				615,617				



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-5(40)

DESCRIPTION: ELIMINATE MEDIAN BREAK AT QUAIL RUN (STA 95+373)

AT QUAIL RUN (STA 95+373) SHEET NO.: 1 of 4

ORIGINAL DESIGN: (Sketch attached)

The planned configuration shows the start of the dedicated left-turn lane for Quail Run approximately 30 meters east of the Wabash Trail intersection. The planned configuration will tempt westbound drivers from Wabash Trail to cross both eastbound lanes and enter the left-turn/u-turn lanes in the space of 30 meters.

ALTERNATIVE: (Sketch attached)

Eliminate the median break at Quail Run and direct the affected traffic to the u-turn lanes planned for Dixie Drive and Vicksburg Trail.

ADVANTAGES:

DISADVANTAGES:

- Increased vehicular/driver safety
- Reduced paved area
- Lower initial costs
- Common practice
- Eliminates close median breaks

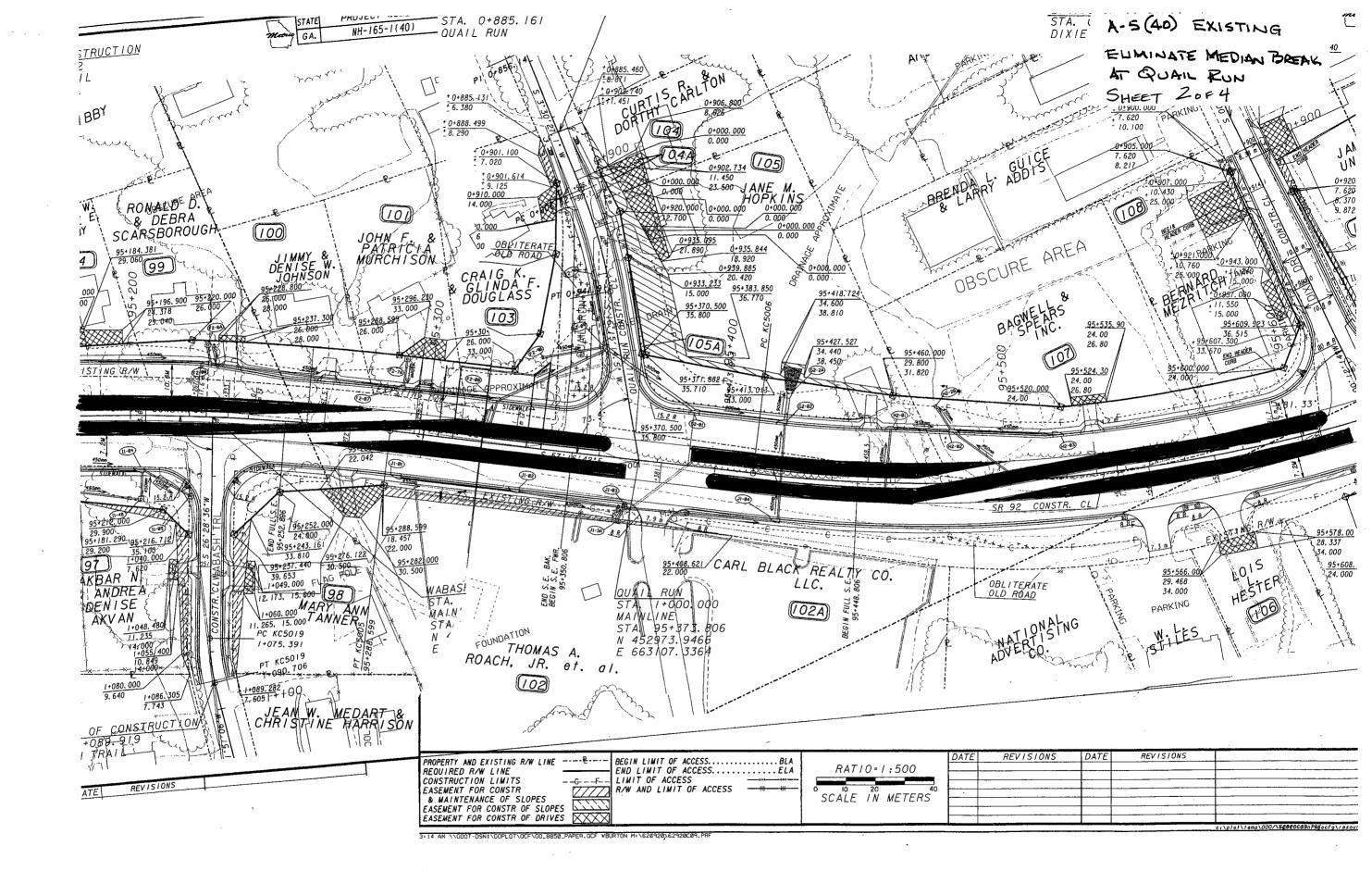
Loss of amenity to make more turns

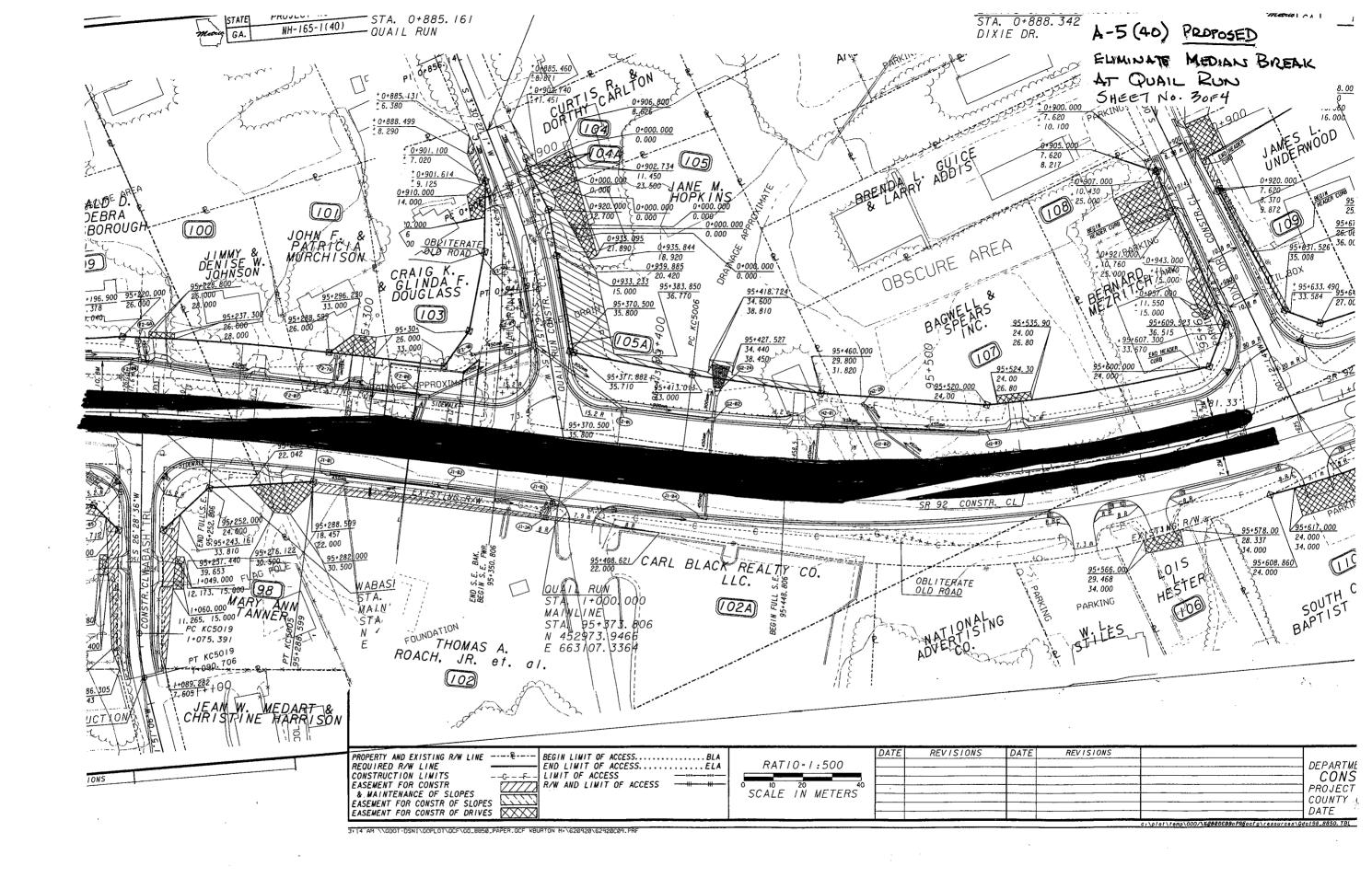
DISCUSSION:

The present average daily traffic (ADT) count from Wabash Trial to SR 92 westbound is 175 in 2003 and rising to a projected 275 in 2027. The present ADT from Quail Run to SR 92 eastbound is 125 in 2003 and rising to a projected 200 in 2027. These are not aggressive increases over a 24-year period and do not warrant a median break.

Eliminating the median break and the left turn lanes at Quail Run will reduce paved area by approximately 2,225 m² allowing for better drainage with less impervious area. This provides for a more environmentally friendly area of the corridor.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	134,924	3/4	\$	134,924
ALTERNATIVE	\$	0	3/4	\$	
SAVINGS	\$	134,924	3/4	\$	134,924





PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-5 (40)

DESCRIPTION: SHEET NO. 4 of 4

CONSTRUCTION ITEM			C	RIGINAL ES	TIMATE	PROPOSED ESTIMATE			
ITEI	VI	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
vement		m ²	2,225	50.00	111,250				
	Sub-total				111,250				
Mark-up at	21.28%				23,674				
	TOTAL				134,924				



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-8(40)

DESCRIPTION: **ELIMINATE MEDIAN BREAK AT STA 95+875**±

SHEET NO.: $1 \ of \ 2$

ORIGINAL DESIGN:

The planned configuration shows a median break at STA 95+875±.

ALTERNATIVE:

Eliminate the median break at STA 95+875± and direct the affected traffic to the U-Turn Lanes planned for Dixie Drive and Elliott Industrial Drive.

ADVANTAGES:

- Increased vehicular/driver safety Loss of
- Reduced paved area
- Lower initial costs
- Common practice
- Eliminates close median breaks

DISADVANTAGES:

• Loss of amenity to make more turns

DISCUSSION:

Eliminating the median break and the left turn lanes at approximately STA $95+875\pm$ will reduce paved area by approximately 2,650 m² allowing for better drainage with less impervious area. This provides for a more environmentally friendly area of the corridor.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	160,696	3/4	\$	160,696
ALTERNATIVE	\$	0	3/4	\$	
SAVINGS	\$	160,696	3/4	\$	160,696

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

A-8 (40)

DESCRIPTION: SHEET NO. 2 of 2

CONS	TRUCTION ITEM		C	ORIGINAL E	STIMATE	PROPOSED ESTIMATE			
ITEI	VI	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
nvement		m^2	2,650	50.00	132,500				
	Sub-total				132,500				
Mark-up at	21.28%				28,196				
	TOTAL				160,696				



PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-1(40)

DESCRIPTION: REDUCE MEDIAN WIDTH TO 6.1 METERS

SHEET NO.: 1 of 4

ORIGINAL DESIGN: (Sketch attached)

The current design calls for the use of a 13.6 m wide median throughout the majority of the project length.

ALTERNATIVE: (Sketch attached)

Reduce the median width from 13.6m to 6.1m.

ADVANTAGES:

- Reduces initial cost
- Reduces right-of-way purchases
- Reduces right-of-way impacts
- Common practice

DISADVANTAGES:

- More difficult to expand in the future
- Not in agreement with current widening project philosophies

DISCUSSION:

Reduce the median to 6.1m to accommodate the current and immediate future need rather then the proposed 13.6m for unknown future expansion. The instant project is, in fact, the needed widening for the immediate future and there are no guarantees that continued expansion will occur beyond the projected demographics along this corridor of SR 92.

Although initial construction costs are reduced, the bulk of the savings is derived from a reduction in the amount of right-of-way needed and its associated impacts.

Consideration could be given to implementing this alternative at specific portions where known growth is immediately needed but not for the entire 4.770 kilometer length of the project.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	15,528,820	3/4	\$	15,528,820
ALTERNATIVE	\$	10,967,696	3/4	\$	10,967,696
SAVINGS	\$	4,561,124	3/4	\$	4,561,124

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

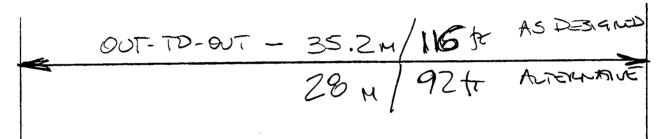
ALTERNATIVE NO.:

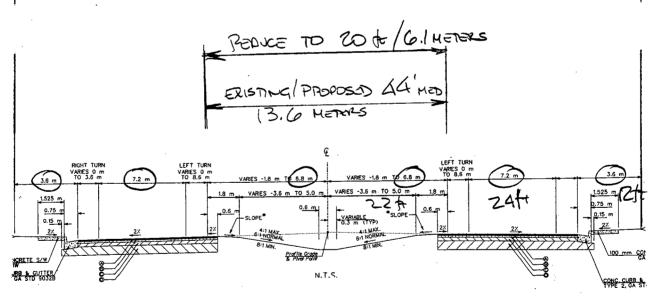
R-1 (40)

AS DESIGNED

ALTERNATIVE

SHEET N O .: 2 of 4





CALCULATIONS _____

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-1(40)

DESCRIPTION:

SHEET NO .: 3 of 4

PEDUCE MEDIAN WIDTH TO 20 JE,
PEDUCE BY ZA FOET.

REDUCE FROM OVERAL OUT-TO-OUT DIMENSIONS

35, 2 m/ 116 t= > 28 m/92 te

20% Review

R/W COSTS - REDICED BY 20%

THERE WILL BE ADDITIONED SNINGS FOR
PHULLIPACTS FOR THIS PROPERT, PETAINING WHUS
PAPKING/EGPESS/ACCESS FOR LOCAL BUSINESSES,
ASSUME \$ 1,500,000

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-1 (40)

DESCRIPTION: SHEET NO. 4 of 4

CONSTRU	CTION ITEM		C	RIGINAL I	STIMATE	Pl	ROPOSED ES	DESTIMATE		
ITEM		UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL		
R/W Costs		LS	1		12,550,000			10,040,000		
M/U @	9.24%				1,159,620			927,696		
Roadway Construction ar	nd	LS	1		1,500,000					
Associated Impacts					319,200					
M/U @	21.28%									
	Sub-total				15,528,820			10,967,696		
Mark-up at					Included			Included		
	TOTAL				15,528,820			10,967,696		



PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-2(40)

DESCRIPTION: REDUCE MEDIAN WIDE TO 1.8 METERS

SHEET NO.: 1 of 4

ORIGINAL DESIGN:

The current design calls for the use of a 13.6 m wide median throughout the majority of the project length.

ALTERNATIVE: (Sketch attached)

Reduce the median width from 13.6m to 1.8m.

ADVANTAGES:

- Reduces initial cost
- Reduces right-of-way purchases
- Reduces right-of-way impacts
- Common practice in high-cost ROW areas

DISADVANTAGES:

- More difficult to expand in the future
- Not in keeping with current widening project philosophies
- Requires transitions at side roads for left turn lanes

DISCUSSION:

Reduce the median to 1.8m with a center concrete barrier to accommodate the current and immediate future need rather then the proposed 13.6m for unknown future expansion. The instant project is, in fact, the needed widening for the immediate future and there are no guarantees that continued expansion will occur beyond the projected demographics along this corridor of SR 92.

Although initial construction costs are reduced, the bulk of the savings is derived from a reduction in the amount of right-of-way needed and its associated impacts.

While this alternative would introduce a physical barrier and require transitions at the side streets for turn lanes, it would significantly reduce the overall width of the project and needed right-of-way purchases, impacts, and costs.

COST SUMMARY	INITIAL COST		PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$	16,135,220	3/4	\$	16,135,220
ALTERNATIVE	\$	12,596,817	3/4	\$	12,596,817
SAVINGS	\$	3,538,403	3/4	\$	3,538,403

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-2(40)

☐ AS DESIGNED

ALTERNATIVE

SHEET NO .: 2 of 4

TRANS COT TRANS LANS

PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-2(40)

DESCRIPTION:

SHEET NO .: 3 of 4

25,2 m/16 to 70 23,4/76 to

24% REDUCTION HOWERDE, WE WILL
HERD TO WIGHT & SIDE STREETS FOR
LOFF, TURN LANGE - USE 25% REDUCTION

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-2(40)

DESCRIPTION: SHEET NO. 4 of 4

CONSTRUCTION	ITEM	(ORIGINAL I	ESTIMATE	P	ROPOSED ES	TIMATE
ITEM	UNIT	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
R/W Costs	LS	1		12,550,000			9,412,500
M/U @ 9.249	%			1,159,620			869,715
Roadway Construction and	LS	1		2,000,000			
Associated Impacts				425,600			
M/U @ 21.28	3%						
New Concrete Barrier	M				4,770	400.00	1,908,000
M/U @ 21.28	3%						406,602
Si	ub-total			16,135,220			12,596,817
Mark-up at				Included			Included
	TOTAL			16,135,220			12,596,817

VALUE ENGINEERING ALTERNATIVE



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-4(40)

DESCRIPTION: ELIMINATE SIDEWALKS FROM WOODLAND DRIVE TO

CHEROKEE TRAIL

SHEET NO.: 1 of 2

ORIGINAL DESIGN:

The current design calls for the use of sidewalks on both sides of SR-92.

ALTERNATIVE:

Eliminate sidewalks in their entirety from the project.

ADVANTAGES:

- Lowers initial costs
- Improves constructibility
- Easier to construct
- Common practice for like applications

DISADVANTAGES:

- Not pedestrian friendly throughout the project
- Does not promote pedestrian traffic
- Not in agreement with GDOT direction

DISCUSSION:

This section of SR-92, though classified as urban, does not currently have and is not anticipated to have any pedestrian traffic due to the nature of the commercial businesses along this portion of the corridor. Although the loss of sidewalks does not promote pedestrian traffic, expenditure of dollars for a facility structure that will likely not be used is inappropriate and funds could be better allocated for other uses.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$ 433,879	3/4	\$	433,879
ALTERNATIVE	\$ 0	3/4	\$	0
SAVINGS	\$ 433,879	3/4	\$	433,879

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-4 (40)

DESCRIPTION: SHEET NO. 2 of 2

CONS	TRUCTION ITEM		C	RIGINAL EST	TIMATE	PROPOSED ESTIMATE			
ITE	М	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
dewalks		m^2	14,310	25.00	357,750				
ı									
	Sub-total				357,750				
Mark-up at	21.28%				76,129				
	TOTAL				433,879				

VALUE ENGINEERING ALTERNATIVE



PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-5(40)

DESCRIPTION: DO NOT OBLITERATE PAVEMENT

SHEET NO.: 1 of 2

ORIGINAL DESIGN:

The original plans call for obliteration of the abandoned pavement of roads being relocated.

ALTERNATIVE:

Leave the abandoned pavement in place and do not obliterate and haul off the excess material.

ADVANTAGES:

- Lowers initial project cost
- Slightly reduces construction time
- Precludes hauling operation

DISADVANTAGES:

- Reduces aesthetics
- Could be perceived as a traffic mis-direction
- Impervious surface remains in place; not environmentally friendly
- Invites loitering; an attractive nuisance

DISCUSSION:

Eliminating obliteration operation of the abandoned roads should be undertaken only as a cost reduction effort. Leaving abandoned pavement in situ is not environmentally friendly and becomes an attractive nuisance for unintended purposes yet carries an undesirable liability.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$ 17,788	3/4	\$	17,788
ALTERNATIVE	\$ 0	3/4	\$	0
SAVINGS	\$ 17,788	3/4	\$	17,788

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-5 (40)

DESCRIPTION: SHEET NO. 2 of 2

CONST	TRUCTION ITEM		C	RIGINAL EST	IMATE	PROPOSED ESTIMATE			
ITEN	M	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
avement Obliteratio	n	m^3	733	10.00	7,330				
Haul to Landfill		m^3	733	10.00	7,330				
	Sub-total				14,660				
Mark-up at	21.28%				3,120				
	TOTAL				17,780				

VALUE ENGINEERING ALTERNATIVE



PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-10(40)

DESCRIPTION: USE A FIVE LANE SECTION FOR WIDENING

SHEET NO.: 1 of 4

ORIGINAL DESIGN:

The current design calls for the use of a 13.6 m wide median throughout the majority of the project length that allows for two-lane traffic in both directions, dedicated left turning lanes, and a median of sufficient width to accommodate a future drive lane for both directions.

ALTERNATIVE: (Sketch attached)

Reduce the median width from 13.6m to 4.3m and provide a fifth turning lane in the median.

ADVANTAGES:

- Reduces initial cost
- Reduces right-of-way purchases
- Reduces right-of-way impacts
- Common practice in high-cost ROW areas

DISADVANTAGES:

- More difficult to expand in the future
- Not in agreement with current widening project philosophies
- Some safety reduction

DISCUSSION:

This alternative would allow for a reduced typical section thereby reducing construction costs and right-of-way costs. A median would not be included and the design speed would have to be reduced. However, due to the highly commercialized nature of the area and this rapidly growing section of the SR 92 corridor, this may be feasible, at least for some portions of the project, like the eastern end closer to Interstate 75.

The savings noted are for a fifth lane to run the entire length of the project at 4.770 kilometers.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$ 13,709,620	3/4	\$	13,709,620
ALTERNATIVE	\$ 10,145,119	3/4	\$	10,145,119
SAVINGS	\$ 3,564,501	3/4	\$	3,564,501

PROIECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

☐ AS DESIGNED

ALTERNATIVE NO.:

R-10(40)

ALTERNATIVE

SHEET NO .: 2 of 4

Asser Mr. 16

JK

+3.6 + 7.2 + 4.3 + 7.2 + 3.6 ×

OUT-TO-OUT 25.9 M/85te 24/0 RED IN EFFERT, REDUCE MEDIAN FROM 44 to TO

CALCULATIONS

PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

, ALTERNATIVE NO.:

R-10(40)

DESCRIPTION:

SHEET NO .: 3 of 4

DVARAL REDUCION IS FROM 35,2M/116/E TO 25.9m/85/E - 76% REDUCTION.

CONSTRUCTION COST ASSUME EQUINS OUT -

AAte GRASSED MEDIAN IS EQUIVARENT TO

15 ABPHAT PARMOUT

COST SAVINGS IS IN P/W

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-10 (40)

DESCRIPTION: SHEET NO. 4 of 4

CONST	TRUCTION ITEM		C	ORIGINAL E	STIMATE	PROPOSED ESTIMATE			
ITEN	VI	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL	
R/W Costs		LS	1		12,550,000			9,287,000	
	Sub-total				12,550,000			9,287,000	
Mark-up at	9.24%				1,159,620			858,119	
	TOTAL				13,709,620			10,145,119	

VALUE ENGINEERING ALTERNATIVE



PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-13 (40)

DESCRIPTION: REDUCE THE HEIGHT OF THE CAST-IN-PLACE GRAVITY

RETAINING WALLS AND USE GUARD RAILS FOR SAFETY

SHEET NO.: 1 of 3

ORIGINAL DESIGN:

The current design calls for the use of numerous cast-in-place (CIP) gravity retaining walls throughout the project area.

ALTERNATIVE:

Reduce the height of the CIP gravity retaining walls by 0.75 meters (m) and provide Type T guard rails for safety.

ADVANTAGES:

- Reduces initial cost
- Slightly easier to erect/construct
- Common practice

DISADVANTAGES:

- Perceived loss of safety
- Loss of some aesthetics

DISCUSSION:

The use of guard rails as safety barriers to reduce the cost associated with the CIP gravity retaining walls is commonly done throughout the State at specific locations. The retaining walls on this project are good candidates for this cost reduction effort.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$ 1,432,620	3/4	\$	1,432,620
ALTERNATIVE	\$ 1,106,074	3/4	\$	1,106,074
SAVINGS	\$ 326,546	3/4	\$	326,546

CALCULATIONS

PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.: R-13 (40)

DESCRIPTION:

SHEET NO.: 2 of 3

LENGTH OF CIP CONC. /GRAVITY WALLS Y = 750 M OVER THE ENTIRE PROJECT Y

AVERAGE THICKNESS OF WATE = 0.35 M

COST OF CONCRETE MCLUDING 3 = \$ 750/M3
REINFORCING STEEL- J

COST OF TYPE TP T GUARDRAIL = \$ 35/M

REDUCTION IN 10TY OF FETAINING WALL : 750 × 0.35 × (2.25×2)

= 1181 M3

NOTE: SEE CIP WALL COST COMPUTATIONS IN R-14 (40)

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-13 (40)

DESCRIPTION: SHEET NO. 3 of 3

CONST	TRUCTION ITEM		C	RIGINAL ES	STIMATE	PI	ROPOSED ES	TIMATE
ITEN	M	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Gravity Retaining Wa	alls	M^3	1,575	750.00	1,181,250	1,181	750.00	885,750
Type T Guardrail		M				750	35.00	26,250
	Sub-total				1,181,250			912,000
Mark-up at	21.28%				251,370			194,074
	TOTAL				1,432,620			1,106,074

VALUE ENGINEERING ALTERNATIVE



PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-14(40)

DESCRIPTION: USE MECHANICALLY STABILIZED EARTH WALLS IN LIEU

OF GRAVITY RETAINING WALLS

SHEET NO.: 1 of 3

ORIGINAL DESIGN:

The current design calls for the use of numerous gravity retaining walls throughout the project area.

ALTERNATIVE:

Use mechanically stabilized earth (MSE) walls in lieu of the proposed gravity retaining walls.

ADVANTAGES:

- DISADVANTAGES:
- Reduces initial cost
- Simpler to construct/erect
- Common practice
- Cost effective
- Improves aesthetics

• Requires slightly more maintenance

DISCUSSION:

MSE walls are easier to construct compared to cast-in-place (CIP) concrete walls, resulting in initial cost savings. Reduced foundation widths for this type of wall are noted that could lead to a reduction in right-of-way needs and cost savings which were not calculated for this alternative. In addition, MSE walls are considered to be more aesthetically pleasing than CIP walls.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$ 1,432,620	3/4	\$	1,432,620
ALTERNATIVE	\$ 1,207,949	3/4	\$	1,207,949
SAVINGS	\$ 224,671	3/4	\$	224,671

CALCULATIONS /



PROIECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-14 (40)

DESCRIPTION:

SHEET NO.: 2 of 3

· LENGTH OF CIP CONC GRAVITY WALLS) = 750 M ONER THE ENTIRE PROTECT 9

AVERAGE HEIGHT OF WALL

= 3M ×2 FOO ACCOUNT FOR

ANERSCE THICKNESS OF WALL

= 0.35 M

VOLUME OF CONCRETE = 750x (3x2) x 0.35

= 1575 M3

CLASS A CONCRETE, INCLUDING 7 = \$ 750/M3
REINFORCING STEEL.

COST OR MSE WALL:

ASSUME MSE WALL PEOTING IS 450 mm × 600 mm

450 hu

AVERAGE HT = 3 M

LENGTH OF PROJECT = 750M

COST OF MSZ WALL/M2 = \$3.75 COST OF CIP FOURATION 2 \$750

: COST OF WALL = 375 x 750 x3 + 750 x 600 x 450 x 750

= \$ 995,828

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-14 (40)

DESCRIPTION: SHEET NO. 3 of 3

CONS	TRUCTION ITEM		C	ORIGINAL ES	STIMATE	PI	ROPOSED ES	TIMATE
ITE	М	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Gravity Retaining W	alls	M^3	1,575	750.00	1,181,250	1,181	750.00	
MSE Walls		M^2				2,250	375.00	843,750
MSE Wall FND		\mathbf{M}^3				203	750.00	152,250
	Calc Act of				1 101 250			004 000
N/lowle con et	Sub-total				1,181,250			996,000
Mark-up at	21.28%				251,370			211,949
	TOTAL				1,432,620			1,207,949

VALUE ENGINEERING ALTERNATIVE



PROJECT: SR 92 WIDENING

NORTHPOINT PARKWAY TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-16(40)

SHEET NO.: 1 of 3

USE KEYSTONE WALLS IN LIEU OF GRAVITY RETAINING DESCRIPTION:

WALLS

The current design calls for the use numerous gravity retaining walls throughout the project area.

ALTERNATIVE:

ORIGINAL DESIGN:

Use keystone walls in lieu of the proposed gravity retaining walls.

ADVANTAGES:

- Reduces initial cost
- Simpler to construct/erect
- Common practice
- Cost effective
- Improves aesthetics
- Lesser foundation right-of-way (savings not calculated)

DISADVANTAGES:

Requires slightly more maintenance

DISCUSSION:

Apart from being easier to construct, keystone walls provide about a 40% savings in the volume of concrete over the cast-in-place (CIP) concrete walls. Reduced foundation widths for this type of wall could lead to a reduction in right-of-way needs and cost savings which were not calculated. In addition, keystone walls are considered to be more aesthetically pleasing than CIP walls.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST	
ORIGINAL DESIGN	\$ 1,432,620	3/4	\$	1,432,620
ALTERNATIVE	\$ 859,572	3/4	\$	859,572
SAVINGS	\$ 573,048	3/4	\$	573,048

CALCULATIONS

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-16 (40)

DESCRIPTION:

SHEET NO .: 2 of 3

LENGTH OF CIP CONCO/GRAVITY WALLS] = 750 M OVER THE ENTIRE PROJECT & = 750 M

AVERHUE HEIGHT OF WALL

= 3 M

X2 TTO ACCOUNT FOR

AVERTUE THICKNESS OF WALL

= 0.35 M

VOLUME OF CONCRETE = 750 x (3x2) x 0.35

e 1575 M3

CLASS & CONCRETE, INCLUDING = \$ 750/M3

COST WORKSHEET

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

ALTERNATIVE NO.:

R-16 (40)

DESCRIPTION: SHEET NO. 3 of 3

CONS	TRUCTION ITEM		C	RIGINAL ES	TIMATE	PI	TIMATE	
ITE	M	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Gravity Retaining W	alls	M^3	1,575	750.00	1,181,250			
Keystone Wall		\mathbf{M}^3				945	750.00	708,750
Assume 60% quanti	ty of CIP)							
	Sub-total				1,181,250			708,750
Mark-up at	21.28%				251,370			150,822
	TOTAL				1,432,620			859,572

PROJECT DESCRIPTION

BACKGROUND

State Route (SR) 92 is the primary east-west corridor through this rapidly developing area in Cherokee County providing access to both Interstate (I) - 75 and I-575. SR 92 is primarily a two-lane road with poor alignment. The majority of the commercial development in southwest Cherokee County is located along SR 92, generating high volume of turning movements and congestion.

The proposed multi-laning of SR 92 will greatly improve its capacity while providing a safer environment for the motorist, reduced travel time, and less congestion.

PROJECT DESCRIPTIONS

Project NH-165-1 (40) consists of the widening and reconstruction of a 4.773 kilometer section of SR 92 from its current two-lane configuration into a four-lane roadway with two lanes in each direction separated by a 44-foot depressed grassed median and three lanes with a 20-foot raised median in the developed area in the vicinity of Bells Ferry Road. This project begins just west of Woodland Drive and continues easterly to Cherokee Trail.

Project NH-165-1 (42) consists of the widening and reconstruction of a 6.838 kilometer section of SR 92 from its current two-lane configuration into a four-lane roadway with two lanes in each direction separated by a 44-foot depressed grassed median. This project begins east of I-75 near Northpoint Parkway and continues to the end of the project west of Woodland Drive and includes the construction of new twin bridges over Clark Creek.

COST DATA

The current probable cost of construction for both projects has been identified at \$95,403,975. This figure is composed of \$24,872,080 for Project 40 and \$70,531,895 for Project 42 that was derived from revised programmed costs dated December 31, 2003, and January 7, 2004, respectively.

The aforementioned costs include \$12,550,000 and \$47,748,000 worth of right-of-way purchases for Projects 40 and 42 respectively. Both projects contain engineering and construction contingencies of 10.00%. Project 40 has an inflation rate of 10.25% (based on 5.00% per annum for two years) while Project 42 has an inflation rate 34.01% (based on 5.00% per annum for six years).

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ALLATOUNA Centon Suffingue DEPAR' ALLATOUNA RED TOP BUILDING Springs	TMENT OF TRANSPORTA' STATE OF GEORGIA	STATE PROJECT NUMBER SHEET TOTAL SHEETS GA. NH-165-1(40) 1
	AN AND PROFILE OF PROPOSED VING OF STATE ROUTE 92 F AND RD. TO CHEROKEE TRA	ROM
LOCATION SKETCH	FEDERAL AID PROJECT	DESIGN DATA: TRAFFIC A. D. T.: 38700 (2007) TRAFFIC A. D. T.: 70000 (2027) TRAFFIC D. H. V.: 3675 (2027) DIRECTIONAL DIST.: 57/43
UECT NH-165-1 (42) BEGIN CONSTRUCTION NH-165-1 (40) +758.183 - 4. 93	NH-165-1(40) FEDERAL ROUTE • NA STATE ROUTE • 92 P. I. NO. 620920 MIDPOINT OF PROJE	% TRUCKS: 4% 24 HR. TRUCKS %: 6% SPEED DESIGN: 70 km HORIZONTAL DATUM: NAD 1983 VERTICAL DATUM: NAVD 1988 ZONE COORDINATES: WEST UNITS: METRIC FUNCTIONAL CLASS:
END FUTURE PRO END FUTURE PRO BEGIN PROJECT & STA 92 STA 92 STA 92 M. P. M. P.	STA 95+144.703 COORDINATES N 453086.865 E 662908.437	PROJECT DESIGNATION: CA PROJECT DESIGNATION: CA OF PROJECT NH-165-1 (55) OF PROJECT NH-165-1 (40)
MODDL AND DRI VE STA 92+91.2. 364 STA 92+91.2. 364 STA 93+59. 892 TASON DRI VE TA 93+559. 892 TA 93+574. 212 TA 93+574. 212 TA 93+569.1717	CROSSINGS OR. STA 94+130. 430 STA 94+130. 430 BELLS FERRY RD. FINALL FOR THE TRAIL. STA 94+316. 095 STA 94+316. 095 STA 94+130. 430 STA 94+130	11 121 2 3 3 4 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
WOODLAND DE STA 92+912. STA 93+250.1 IYSON DRIV STA 93+254.2 STA 93+574.2 ROBIN ROAD	VI CKSBURG TR STA 94+766 STA 95+152. STA 95+152. STA 95+152. STA 95+152. STA 95+152.	STA 96 STA 96 STA 96 STA 96 STA 97 ST
NH-165-1 (40) RW, CONSTR, P. E. NOTE: ALL REFERENCES IN THIS DOCUMENT. WHICH INCLUDES ALL PAPERS. WRITINGS, DOCUMENTS, DRAWINGS, OR PHOTOGRAPHS USED. OR TO BE USED IN CONNECTION WITH THIS DOCUMENT. TO 'STATE HIGHWAY DEPARTMENT OF GEORGIA'. 'STATE HIGHWAY DEPARTMENT'. 'HIGHWAY DEPARTMENT'. 'HIGHWAY DEPARTMENT'. 'HIGHWAY DEPARTMENT'. OR 'DEPARTMENT WHEN THE CONTEXT THEREOF MEANS THE STATE HIGHWAY DEPARTMENT OF GEORGIA MEAN, AND SHALL BE DEEMED TO MEAN THE DEPARTMENT OF TRANSPORTATION.	WABASH TRAIL STA 95+227.949 STA 95+625.506 STA 96+ 099.25 IND STA 96+ 099.25	SUBMITTED BY: STATE ROAD AND AIRPORT DESIGN ENGINEER DATE CHIEF ENGINEER PLANS COMPLETED REVISIONS
THE DATA, TOGETHER WITH ALL OTHER INFORMATION SHOWN ON THESE PLANS OR IN ANYWAY INDICATED THEREBY, WHETHER BY DRAWINGS OR NOTES, OR IN ANY OTHER MANNER, ARE BASED UPO FIELD INVESTIGATIONS AND ARE BELIEVED TO BE INDICATIVE OF ACTUAL CONDITIONS. HOWEVER, THE SAME ARE SHOWN AS INFORMATION ONLY, ARE NOT GUARANTEED, AND DO NOT BIND THE DEPARTMENT OF TRANSPORTATION IN ANY WAY. THE ATTENTION OF BIDDER IS SPECIFICALLY DIRECTED TO AND OF THE SPECIFICATIONS.	SCALE RATIO 1TO 8000	

DEPARTMENT OF TRANSPORTATION menue STATE OF GEORGIA

PROJECT NUMBER GA. NH-165-1(42)

LOCATION SKETCH PROJECT LOCATION

THIS PROJECT IS CREATED USING THE GEORGIA STATE PLANE COORDINATE SYSTEM OF 1983/1984 (NAD 1983). WEST ZONE; AND THE NORTH AMERICAN VERTICAL DATUM (NAVD) 1988.

AND PROFILE OF PROPOSED PLAN S.R. 92 WIDENING FROM NORTHPOINT PARKWAY TO WOODLAND DRIVE CHEROKEE COUNTY

> FEDERAL AID PROJECT NH-165-1(42)

> > STATE ROUTE * 92 P.I. NO. 620940

NOTE :
ALL REFERENCES IN THIS DOCUMENT, WHICH INCLUDES ALL PAPERS. WRITINGS.
DOCUMENTS, DRAWINGS, OR PHOTOGRAPHS USED, OR TO BE USED IN CONNECTION
WITH THIS DOCUMENT, TO 'STATE HIGHWAY DEPARTMENT OF GEORGIA ', 'STATE
HIGHWAY DEPARTMENT ', OEORGIA STATE HIGHWAY DEPARTMENT ', 'HIGHWAY
DEPARTMENT_", OR 'DEPARTMENT ' WHEN THE CONTEXT THEREOF MEANS THE STATE HIGHWAY DEPARTMENT OF GEORGIA MEAN, AND SHALL BE DEEMED TO MEAN THE DEPARTMENT OF TRANSPORTATION.

DESIGN GROUP MANAGER

END BRIDGE MIDPOINT OF PROJECT STA 86+878.00 STA 89+381.00 N 454395.4236 PREPARED BY: RECOMMENDED FOR SUBMISSION BY URS-ATLANTA ROADWAY DESIGN MANAGER RECOMMENDED FOR SUBMISSION BY: SUBMITTED BY: STATE ROAD AND AIRPORT DESIGN ENGINEER BEGIN BRIDGE STA 86+530.00 BEGIN PROJECT NH-165-1(42) STA 85+962.00 (MP:0.39m, KmP:0.63km) DESIGN DATA TRAFFIC A.D.T.(2000): 23.500 RATIO-1:10,000 TRAFFIC A.D.T.(2020):40.000 END PROJECT NH-165-1(42) TRAFFIC D.H.V.(2020):AM-3670.PM-3670 SCALE IN METERS TIE TO PROJECT NH-165-1(40) DIRECTIONAL DIST. AM-40% NB/60% SB

> FUNCTIONAL CLASSIFICATION: URBAN PRINCIPAL ARTERIAL PROJECT DESIGNATION: CA

70 KM/H

DIRECTIONAL DIST. PM-60% NB/40% SR

E MAX: 6% (8% FOR SIDESTREETS)

THE DATA. TOGETHER WITH ALL OTHER INFORMATION SHOWN ON THESE PLANS OR IN ANYWAY INDICATED THEREBY, WHETHER BY DRAWINGS OR NOTES. OR IN ANY OTHER MANNER. ARE BASED UPON FIELD INVESTIGATIONS AND ARE BELIEVED TO BE INDICATIVE OF ACTUAL CONDITIONS... HOWEVER. THE SAME ARE SHOWN AS INFORMATION ONLY. ARE NOT QUARANTEED. AND DO NOT BIND THE DEPARTMENT OF TRANSPORTATION IN ANY WAY. THE ATTENTION OF BIDDER IS SPECIFICALLY DIRECTED TO SUBSECTIONS 102.04. 102.05. AND 104.03 OF THE SPECIFICATIONS.

% TRUCKS: 4% 24 HR. TRUCKS 4% SPEED DESIGN

THIS PROJECT IS LOCATED 100% IN CHEROKEE COUNTY.
THIS PROJECT IS LOCATED 100% IN CONGRESSIONAL DISTRICT 6.

Cherokee Co LENGTH OF ROADWAY 6.490 KM 0.348 KM LENGTH OF BRIDGES LENGTH OF EXCEPTIONS 0.000 KM TOTAL LENGTH OF PROJECT 6.838 KM

STA 92+800.00 (MP:4.64m ·KmP:7.47km)

CHIEF ENGINEER L & D APPROVED SEPT. 8. 1998 PLANS COMPLETED - -REVISIONS

VALUE ANALYSIS AND CONCLUSIONS

GENERAL

This section describes the value analysis procedure used during the value engineering study. It is followed by separate narratives and conclusions concerning:

- Value Engineering Workshop Participants
- Economic Data
- Cost Estimate Summary and Cost Histograms
- Function Analysis
- Creative Idea Listing and Judgment of Ideas

A systematic approach was used in the VE study and the key procedures involved were organized into three distinct parts: 1) preparation; 2) VE workshop; and 3) post-study. A Task Flow Diagram that outlines each of the procedures included in the VE study is attached for reference.

PREPARATION EFFORT

Pre-study preparation for the VE effort consisted of scheduling study participants and tasks; gathering necessary background information on the facility; and compiling project data into a cost model and graphic cost histogram. Information relating to the design, construction, and operation of the facility is important as it forms the basis of comparison for the study effort. Information relating to funding, project planning, operating needs, systems evaluations, basis of cost, soil conditions, and construction of the facility was also a part of the analysis.

VALUE ENGINEERING WORKSHOP EFFORT

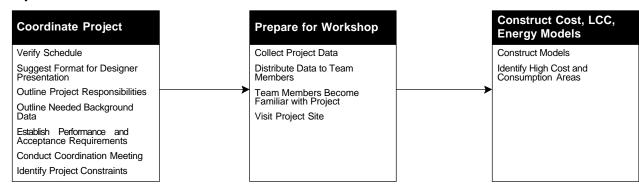
The VE workshop was a three-day effort (see attached agenda). During the workshop, the VE job plan was followed. The job plan guided the search for high cost areas in the project and included procedures for developing alternative solutions for consideration. It includes six phases:

- Information Phase
- Function Identification and Analysis Phase
- Creative Phase
- Evaluation Phase
- Development Phase
- Presentation Phase (*Not conducted*)

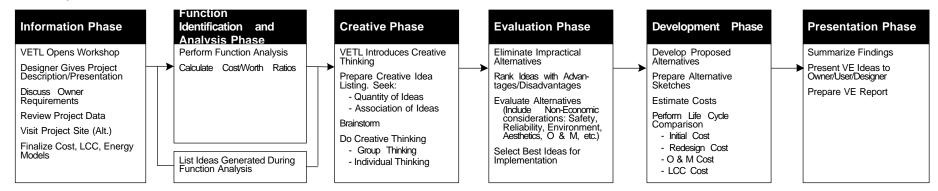


Value Engineering Study Task Flow Diagram

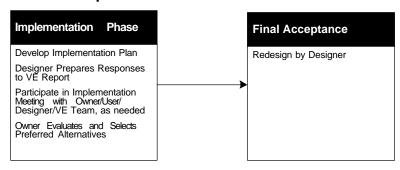
Preparation Effort



Workshop Effort



Post-Workshop Effort



Information Phase

At the beginning of the study, the conditions and decisions that have influenced the development of the project must be reviewed and understood. For this reason, the development manager presented information about the project to the VE team on the first day of the session. Following the presentation, the VE team discussed the project using the following documents:

- Half-Size 90% Design Drawings entitled Plan and Profile of proposed Widening of State Route 92 from Woodland Rd. to Cherokee Trail, Cherokee County, Federal Aid Project NH-164-1 (40), P. I. No. 620920, prepared by the Department of Transportation, State of Georgia, dated March 15, 2004;
- Interdepartment Correspondence with Project Concept Report for the NH-165-1 (40),
 Cherokee County, Widening of State Route 92 from Woodland Drive to Cherokee Trail,
 containing Revision to Programmed Costs, Revised Project Concept Report Approval, and
 numerous other documentation dated between May 14, 1991, and December 31, 2003;
- Half-Size 90% Design Drawings entitled Plan and Profile of proposed S.R. 92 Widening from Northpoint Parkway to Widening Woodland Drive, Cherokee County, Federal Aid Project NH-164-1 (42), P. I. No. 620940, prepared by URS of Atlanta, Georgia, dated January 3, 2093;
- Interdepartment Correspondence with *Project Concept Report* for the NH-165-1 (42),
 Cherokee County, Widening and Reconstruction of State Route 92 from Woodland Drive to Cherokee Trail, containing Revision to Programmed Cost, Revised Project Concept Report Approval, and numerous other documentation dated between September 16, 1991 and January 4, 2004; and
- Bridge Foundation Investigation for **SR 92 over Clark Creek**, dated July 31, 2001.

Function Identification and Analysis Phase

Based on historical and background data, a cost model and graphic function analysis were developed for this project by major construction elements. They were used to distribute costs by project element; serve as a basis for alternative functional categorization; and to assign worth to the categories. Worth is defined as the least cost to provide the required function, as determined by the VE team. The VE team identified the functions of the various project elements and subsystems by using random function generation techniques resulting in the attached Random Function Analysis worksheet and Function Analysis Systems Technique (F.A.S.T.) diagram.

Creative Phase

This VE study phase involved the creation and listing of ideas. Creative idea worksheets were organized by project element. During this phase, the VE team developed as many ideas as possible to provide the necessary functions within the project at a lower cost to the owner, or to improve the quality of the project. Judgment of the ideas was restricted at this point. The VE team was looking for a large quantity of ideas and association of ideas.

The Georgia Department of Transportation (GDOT) representatives may wish to review the creative list since it may contain ideas that can be further evaluated for potential use in the design.

Evaluation Phase

During this phase of the workshop, the VE team judged the ideas generated during the creative phase. Advantages and disadvantages of each idea were discussed to find the best ideas for development. Ideas found to be irrelevant or not worthy of additional study were discarded. Those that represented the greatest potential for cost savings or improvement to the project were then developed further. The VE team would like to develop all ideas, but time constraints usually limit the number that can be developed. Therefore, each idea was compared with the present schematic design concepts, in terms of how well it met the design intent. Advantages and disadvantages were discussed, and each team member rated the ideas on a scale of zero to five, with the best ideas rated five. Total scores were summed for each idea and only highly-rated ideas were developed into alternatives. In cases where there was little cost impact, but an improvement to the project was anticipated, the designation DS (design suggestion) was used. The design team should review this listing for possible incorporation of ideas into the project.

The creative listing was re-evaluated frequently during the process of developing alternatives. As the relationship between creative ideas became more clearly defined, their importance and ratings may have changed, or they may have been combined into a single alternative. For these reasons, some of the originally high-rated items may not have been developed into alternatives.

Development Phase

During the development phase, each highly rated idea was expanded into a workable solution. The development consisted of a description of the alternative, life cycle cost comparisons, where applicable, and a descriptive evaluation of the advantages and disadvantages of the proposed alternatives. Each alternative was written with a brief narrative to compare the original design to the proposed change. Sketches and design calculations, where appropriate, were also prepared in this part of the study. The VE alternatives are included in the section entitled *Study Results*.

Presentation Phase

The last phase of the VE study would have been to present the findings of the study; however, GDOT now conducts the presentation internally upon receipt of the report. The VE alternatives were screened by the VE team before draft copies of the *Summary of Potential Cost Savings* worksheets were provided to GDOT representatives. The VE alternatives were arranged in the same order as the idea listing sheets to facilitate cross-referencing.

POST-WORKSHOP EFFORT

The post-study portion of the VE study includes the preparation of this Value Engineering Study Report. Personnel from GDOT will analyze each alternative and prepare a short response, recommending either incorporation into the project, modifications before implementation, or reasons for rejection. Lewis & Zimmerman Associates, Inc. is available at your convenience as you review the alternatives. Please do not hesitate to call on us for clarification or further information as you consider an implementation approach.

VALUE ENGINEERING STUDY AGENDA

Lewis & Zimmerman Associates, Inc. (LZA) will conduct a 24-hour VE Study on the **State Road** (**SR**) **92 Widening from North Point Parkway to Woodland Drive** and the **SR 92 Widening from Woodland Drive to Cherokee Trail, Project Nos. NH-165-1** (**42**) **P.I. No. 620940** and **NH-165-1** (**40**) **P.I. No. 620920**, respectively, located in Cherokee County, Georgia. It is expected the owner, the Georgia Department of Transportation (GDOT) will be available to make a formal presentation concerning the project at the beginning of the workshop and be available to answer questions during the VE study effort.

VE Study Agenda

The VE study will follow the outline described below and be conducted April 12 – 14, 2004. The study will be conducted in Room 274 in GDOT's General Office located at No. 2 Capitol Square Street, Atlanta, Georgia 30334. The point-of-contact is Ms. Lisa L. Myers, Design Review Engineer Manager, who can be reached at 404-651-7468.

Monday, April 12th

9:00 am - 9:15 am General Introduction of all Parties and review of the VE Process

9:15 am - 11:15 am **Owner's / Designer's Presentation**

GDOT is to present information concerning the project including, but not necessarily limited to: rationale for design; criteria for specific areas of study, project constraints and the reasons for design decisions.

11:00 am - 12:00 noon Commence Function Analysis Phase

The VE team will continue their familiarization with the cost models and project data for each area of study. The cost model(s) will be refined, as necessary; define the function of each project element or system in the cost model, select the primary or basic functions, and determine the worth, or least cost, to provide the function. Cost / worth or value index ratios will be calculated, and high cost / low worth areas for study identified. In addition, the VE team will continue defining the function of each element / system to gain a thorough understanding of the project's needs and requirements.

12:00 noon - 1:00 pm **Lunch**

1:00 pm - 5:00 pm Conclude the Function Analysis Phase and Commence the Creative Phase

The VE team will conduct a brainstorming session and list as many ideas as possible for consideration. The aim is to obtain a large quantity of ideas through free association, by eliminating roadblocks to creativity and deferring judgment.

Tuesday, April 13th

8:30 am - 10:00 am Conclude Creative Phase and Complete Evaluation / Analytical

Phase

The VE team will analyze the ideas listed in the creative phase and select the best ideas for further development.

10:00 am - 12:00 noon **Development Phase**

VE team will develop creative ideas into alternate design solutions. Initial and life cycle cost estimates comparing original and proposed alternatives will be prepared. Selected alternatives for change will be developed and supported with sketches, calculations and written substantiation.

12:00 noon - 1:00 pm **Lunch**

1:00 pm - 5:00 pm **Continue Development Phase**

Wednesday, April 14th

8:30 am - 12:00 am **Continue Development Phase**

12:00 noon - 1:00 pm **Lunch**

1:00 pm - 4:00 pm Conclude Development Phase and Commence Summary

Worksheets

Upon completion of the Development Phase, the VE facilitator will commence preparation of the summary worksheets based on the alternatives developed by the VE team. The summary work sheets form the basis of the informal oral presentation.

4:00 – 5:00 pm Finalize Summary Worksheets

The VE team will provide draft copies of the *Summary of Potential Cost Savings* worksheets to GDOT representatives and be available to clarify any points.

VALUE ENGINEERING WORKSHOP PARTICIPANTS

The VE team was organized to provide specific expertise on the unique project elements involved. Team members consisted of a multidisciplinary group with professional design experience and a working knowledge of VE procedures. The VE team included the following professionals:

Luis M. Venegas, PE, CVS-Life	VE Facilitator	Lewis & Zimmerman Associates, Inc.
William A. Craig, Jr., AVS	Constructibility/	Lewis & Zimmerman Associates, Inc.
	Assistant VE Facilitator	
Ramesh Kalvakaalva, PE	Structural Engineer	Delon Hampton & Associates, Chartered
George A. Obaranec, PE	Civil/Roadway Engineer	Delon Hampton & Associates, Chartered

OWNER'S/DESIGNER'S PRESENTATION

Representatives from the State of Georgia Department of Transportation (GDOT) administration and design team presented an overview of the project on Monday, April 12, 2004. The purpose of this meeting, in addition to being an integral part of the Information Gathering Phase of the VE Study, was to bring the VE team "up-to-speed" regarding the overall project. Additionally, the meeting afforded the design team the opportunity to highlight in greater detail those areas of the project requiring additional or special attention.

VALUE ENGINEERING TEAM'S FINAL PRESENTATION

The VE team did not conduct a final, oral presentation on Wednesday, April 14, 2004, to GDOT. However, copies of the draft *Summary of Potential Cost Savings* worksheets were provided for interim use by GDOT personnel.

A copy of the meeting participants is attached for reference.

VALUE ENGINEERING STUDY

PARTICIPANTS

PROJECT: **SR 92 WIDENING NORTHPOINT DRIVE TO CHEROKEE TRAIL**

Final Design Development

DATE: **April 12 - 14, 2004**

NAME & E-MAIL (PLEASE PRINT)	ORGANIZATION/TITLE	PHONE/FAX
Corey Carter	State of Georgia, Department of Transportation (GDOT), Office of Environmental/Location	ph: 404-699-4441
em: michael.murdock@dot.state.ga.us	Environmental Analyst	fx: 404-699-4440
Dickey Forrester	GDOT, Office of Construction	ph: 404-656-5306
em: dickey.forrester@dot.state.ga.us	Construction Liaison Engineer for Districts 1 and 6	fx: 404-657-0758
Jason L. McCook	GDOT, Office of Road & Airport Design (OR&AD)	ph: 404-656-5406
em: jason.mccook@dot.state.ga.us	Design Group Manager	fx: 404-657-0653
Gerald A. Milligan	GDOT, General Office (GO)	ph: 404-463-2575
em: jerry.milligan@dot.state.ga.us	Right-of-Way	fx: 404-651-5209
Lisa L. Myers	GDOT, GO	ph: 404-651-7468
em: lisa.myers@dot.state.ga.us	Design Review Engineer Manager	fx: 404-463-6131
Stan Petoski	GDOT, Office of Traffic and Safety Design	ph: 404-635-8126
em: stan.petoski@dot.state.ga.us	Project Design Reviewer	fx: 404-635-8116
Kinney Wilson	GDOT, OR&AD	ph: 404-651-9757
em: kinney.wilson@dot.state.ga.us	Road Design	fx: 404-463-0653
Kenney Beckworth	GDOT, District 6	ph: 770-387-3609
em: kenney.beckworth@dot.state.ga.us	Construction	fx: None Provided
Stephen Livey	GDOT, District 6	ph: 770-387-3609
em: stephen.livey@dot.state.ga.us	Construction	fx: None Provided
Ramesh Kalvakaalva, PE	Delon Hampton & Associates, Chartered (DHA)	ph: 404-524-8030
em: rkalvakaalva@delonhampton.com	Senior Structural Engineer	fx: 404-524-2575
George A. Obaranec, PE	DHA	ph: 404-524-8030
em: gobaranec@delonhampton.com	Project Manager	fx: 404-524-2575

VALUE ENGINEERING STUDY PARTICIPANTS



PROJECT: **SR 92 WIDENING NORTHPOINT DRIVE TO CHEROKEE TRAIL**

DATE: **April 12 - 14, 2004**

Final Design Development

NAME & E-MAIL (PLEASE PRINT)	ORGANIZATION/TITLE	PHONE/FAX
William N. Craig, Jr., AVS	Lewis & Zimmerman Associates, Inc.	ph: 936-632-8368
em: bcraig@superiorproject.com	Constructibility, Asst. VE Facilitator	fx: None Available
Luis M. Venegas, PE, CVS-Life	Lewis & Zimmerman Associates, Inc.	ph: 770-992-3032
em: lmvenegas@aol.com	VE Facilitator	fx: 770-992-0228
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ECONOMIC DATA

The VE team developed economic criteria used for evaluation with information gathered from the State of Georgia Department of Transportation. To express costs in a meaningful manner, the VE team alternatives are presented on the basis of discounted present worth. Criteria for planning project period interest rates are based on the following parameters:

Year of Analysis: 2004

Construction Start Up: 2005 (for NH-165-1 (40))

2007 (for NH-165-1 (42))

Construction Duration: $\pm 24 - 30$ Months (both projects)

Economic Planning Life: 35 years starting in 2007/2009 pavements Economic Planning Life: 50 years starting in 2007/2009 bridges

Discount Rate/Interest: 3.00% (Latest United States Office of

Management and Budget Circular A-94)

Inflation/Escalation Rate: 5.00% (GDOT)

Uniform Present Worth (UPW) Factor: 21.4872 for 35 years

25.7298 for 50 years

Cost of Power: \$0.07/kWHr (kilowatt hour) (assumed)

Operation and Maintenance Costs (*Industry Norms*):

Equipment - With Many Moving Parts 5.00%-5.50%+ of Capital Cost Equipment - With Minimal Moving Parts 3.50%-4.00% of Capital Cost

Equipment - Electronic 3.00% of Capital Cost

Structural 1.00%-2.00% (or less) of Capital Cost

Overall Composite Mark-Up: 10.97% (1.1097)

(Composed of: E&C [minus ROW costs] at 10.00% for both projects; Inflation at 5.00% for two years for Project 40 for a factor of 10.25%, and Inflation at 5.00% for six

years for Project 42 for a factor of 34.01%)

Composite Mark-Up for Project 42: 44.01% (1.4401)

(Composed of: E&C at 10.00% and Inflation at 5.00% for

six years for a factor of 34.01%)

Composite Mark-Up for Project 40:

(Composed of: E&C at 10.00% and Inflation at 5.00% for two years for a factor of 10.25%)

Composite Mark-Up for Bridge:

(Composed of: E&C at 10.00% and Inflation at 5.00% for six years for a factor of 34.01%; however, due to lump sum pricing of the bridge, it is skewed due to ROW costs – see Cost Histograms)

21.28% (1.2128)

11.59% (1.1159)

COST ESTIMATE SUMMARY AND COST HISTOGRAMS

The VE team prepared various cost models for the project that are included on the following page. The cost models are arranged in the Pareto Charting/Cost Histogram format to aid in identifying high cost areas and are based on the *Revision to Programmed Costs for NH-165-1 (40) Cherokee County dated December 31, 2003. and Revision to Programmed Costs for NH-165-1 (42) Cherokee County dated January 7,2004*, prepared by the Georgia Department of Transportation. As can be expected, judgments at this stage of the study are based on experience and intuition rather than facts, which are not uncovered until the analysis of function has begun. As a result of these qualified hypotheses, there appears to be a potential for initial savings in the following areas:

NH-165-1 (40), Widening of State Route 92 from Woodland Rd. [sic] to Cherokee Trail, Cherokee County	NH-165-1 (42), S. R. 92 Widening from Northpoint Parkway to Woodland Drive, Cherokee County
Right-of Way	Right-of-Way
Construction	Roadway Items
Reimbursable utilities	Bridge
	Erosion Control
	Signing and Marking

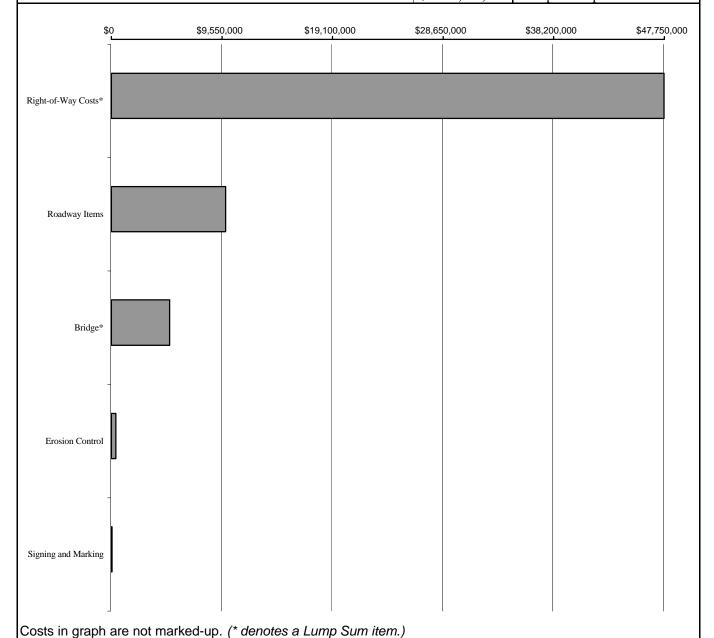
	DENING DINT DRIVE TO (In Development	CHEROKEE 7	FRAIL Pi	oj. N	los. NH-165	5-1 (42)	& (40)		
TOTAL I	PROJECTS	S 40 and 4	42		COST	PER	CENT	CUM Percei	
Right-of-Way Costs (42)	*				47,748,000		55.54%	55	5.549
Right-of-Way Costs (40)					12,550,000		14.60%		0.149
Construction (40)					9,892,459		11.51%		1.649
Roadway Items (42)					9,889,592		11.50%		3.159
Bridge (42)*					5,049,950		5.87%		9.029
Erosion Control (42)					422,199		0.49%		9.519
Reimbursable Utilities (40)				325,000		0.38%		9.899
Signing and Marking (42					94,343		0.11%		0.009
organing and Marking (42	2)		Subtotal		85,971,544		100.00%	100	5.007
E 0-C	(Missas Disable of Wa	C+-) (12) @	10.00%		1,545,608		100.00%		
nflation @ 5.00% / Yea	(Minus Right-of-War for Six Years (Minu		34.01%		5,782,202				
E&C (Minus R	ight-of-Way Costs an		10.00%		989,246				
Inflation @ 5.00% / Way		Minus Right-of-	10.25%		1,115,375				
			TOTAL	\$	95,403,975	Comp	Markup	10.979	%
			l		, ,				
\$0	\$9,550,000	\$19,100,	000	\$28,6	550,000	\$38,20	00,000	\$47,750	0,000
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Right-of-Way Costs (42)*									
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Right-of-Way Costs (40)*									
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Construction (40)									
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Roadway Items (42)									
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Bridge (42)*									
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Reimbursable Utilities									
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Signing and Marking (42)									
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PROJECT: **SR 92 WIDENING**

NORTHPOINT DRIVE TO WOODLAND DRIVE Proj. No. NH-165-1 (42)

Final Design Development

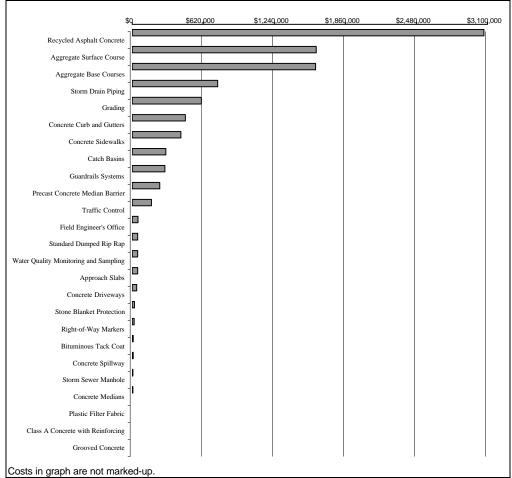
TOTAL PROJECT 42		COST	PERCENT	CUM. PERCENT
Right-of-Way Costs*		47,748,000	75.55%	75.55%
Roadway Items		9,889,592	15.65%	91.19%
Bridge*		5,049,950	7.99%	99.18%
Erosion Control		422,199	0.67%	99.85%
Signing and Marking		94,343	0.15%	100.00%
	Subtotal	63,204,085	100.00%	
E&C (Minus Right-of-Way Costs) @	10.00%	1,545,608		
Inflation @ 5.00% / Year for Six Years (Minus Right-of- Way Costs)	34.01%	5,782,202		
	TOTAL	\$ 70,531,895	Comp Markup	11.59%





PROJECT: SR 92 WIDENING NORTHPOINT DRIVE TO WOODLAND DRIVE Proj. No. NH-165-1 (42) Final Design Development

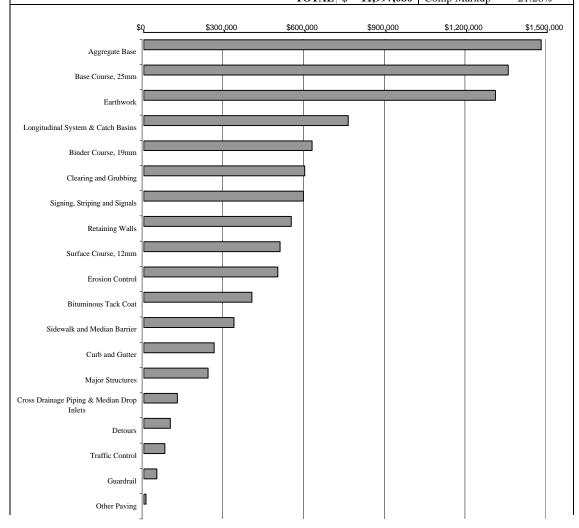
ROADWAY ITEMS 42		COST	PERCENT	CUM. PERCENT
Recycled Asphalt Concrete		3,073,083	31.07%	31.07%
Aggregate Surface Course		1,608,000	16.26%	47.33%
Aggregate Base Courses		1,603,530	16.21%	63.55%
Storm Drain Piping		749,701	7.58%	71.13%
Grading		604,840	6.12%	77.24%
Concrete Curb and Gutters		465,542	4.71%	81.95%
Concrete Sidewalks		427,581	4.32%	86.28%
Catch Basins		297,054	3.00%	89.28%
Guardrails Systems		287,638	2.91%	92.19%
Precast Concrete Median Barrier		242,872	2.46%	94.64%
Traffic Control		169,534	1.71%	96.36%
Field Engineer's Office		51,904	0.52%	96.88%
Standard Dumped Rip Rap		50,680	0.51%	97.39%
Water Quality Monitoring and Sampling		49,955	0.51%	97.90%
Approach Slabs		49,180	0.50%	98.40%
Concrete Driveways		41,878	0.42%	98.82%
Stone Blanket Protection		21,025	0.21%	99.03%
Right-of-Way Markers		20,347	0.21%	99.24%
Bituminous Tack Coat		12,469	0.13%	99.37%
Concrete Spillway		10,509	0.11%	99.47%
Storm Sewer Manhole		9,591	0.10%	99.57%
Concrete Medians		8,021	0.08%	99.65%
Plastic Filter Fabric		3,243	0.03%	99.68%
Class A Concrete with Reinforcing		3,231	0.03%	99.72%
Grooved Concrete		1,185	0.01%	99.73%
<u>-</u>	Subtotal	9,889,593	100.00%	
E&C at	10.00%	988,959		
Inflation @ 5.00% / Year for Six Years	34.01%	3,363,407		
	TOTAL	\$ 14,241,960	Comp Markup:	44.01%





PROJECT: SR 92 WIDENING WOODLAND DRIVE TO CHEROKEE TRAIL Proj. No. NH-165-1 (40) Final Design Development

CONSTRUCTION 40		COST	PERCENT	CUM. PERCENT
Aggregate Base		1,478,400	14.94%	14.94%
Base Course, 25mm		1,355,508	13.70%	28.65%
Earthwork		1,308,000	13.22%	41.87%
Longitudinal System & Catch Basins		761,250	7.70%	49.56%
Binder Course, 19mm		627,264	6.34%	55.91%
Clearing and Grubbing		600,000	6.07%	61.97%
Signing, Striping and Signals		595,000	6.01%	67.99%
Retaining Walls		550,000	5.56%	73.55%
Surface Course, 12mm		508,332	5.14%	78.68%
Erosion Control		500,000	5.05%	83.74%
Bituminous Tack Coat		403,000	4.07%	87.81%
Sidewalk and Median Barrier		336,680	3.40%	91.22%
Curb and Gutter		263,025	2.66%	93.87%
Major Structures		240,000	2.43%	96.30%
Cross Drainage Piping & Median Drop Inlets		126,000	1.27%	97.57%
Detours		100,000	1.01%	98.58%
Traffic Control		80,000	0.81%	99.39%
Guardrail		50,000	0.51%	99.90%
Other Paving		10,000	0.10%	100.00%
	Subtotal	9,892,459	100.00%	
E&C at	10.00%	989,246		
Inflation @ 5.00% / Year for Two Years	10.25%	1,115,375		
	TOTAL	\$ 11,997,080	Comp Markup	21.28%



FUNCTION ANALYSIS

A function analysis was performed to: (1) define the requirements for each project element, and (2) to ensure a complete and thorough understanding by the VE team of the basic function(s) needed to attain a given requirement. A *Random Function Analysis* worksheet for the project is attached. This part of the function analysis stimulated the VE team members to think in terms of the areas in which to channel their creative idea development.

Function Analysis is a means of evaluating a project to see if the expenditures actually perform the requirements of the project, or if there are disproportionate amounts of money spent on support functions. These elements add cost to the final product, but have a relatively low worth to the basic function.

In addition to the random function analysis, the VE Facilitator worked with members of the study team to develop a Function Analysis System Technique (F.A.S.T.) diagram. The F.A.S.T. diagram was used to show the flow of function within the project. It helps to confirm the project is addressing those issues that have been deemed important by the owner. The diagram was generated by asking the key question: "What is the most important function to be accomplished by this phase?" The answer is characterized by a verb/noun pair. In turn, another question is asked: "Why?" The answer is again listed in a verb/noun pair, and the process continued from left to right. If the result is a true F.A.S.T. diagram, the flow of functions from right to left will answer the question "Why?" No F.A.S.T. diagram is ever completed. The readers of this report may wish to challenge themselves to see how far they can carry the construction of the F.A.S.T. diagram.

This F.A.S.T. diagram notes the critical function path and identifies the project's basic function as: **UPGRADE/CORRIDOR** by **INCREASING/CAPACITY** and **WIDENING/HIGHWAY** and is included at the end of this section of the report.

RANDOM FUNCTION ANALYSIS



SHEET NO.: 1 of 1

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

DESCRIPTION	FUNCTION					
DESCRIPTION	VERB	NOUN	KIND			
STATE ROAD 92 WIDENING	Improve	Safety	О			
	Reduce	Congestion	В			
	Increase	Capacity	В			
	Improve	Alignment	S			
	Connect	Corridor	N/A			
	Upgrade	Corridor	В			
	Facilitate	Access	RS			
	Conserving	Wetland Resources	RS			
	Spanning	Wetland	RS			
	Crossing	Wetland	RS			
	Permit	Future Growth	НС			
	Regulate	Traffic Flow	S			
	Accommodate	Future Growth	НС			
	Define	Path	N/A			
	Impact	Environment	S/U			
	Preclude	Inappropriate Use	S			
	Extend	Pavement Life	G			
	Reduce	O&M Costs	G			
	Maintain	Current Traffic (During Construction Only)	RS/			
	Create	Jobs	S			
	Realign	Crossing/Intersections	S			
	Acquire	Property	RS			
	Control	Erosion	RS			
	Relocate	Utilities	RS			
	Control	Storm Water	RS			

Function defined as: Action Verb

Measurable Noun

Kind: B =Basic

> S =Secondary

RS = Required Secondary

HO = Higher Order

LO = Lower Order 0 = Objective

G = Goal

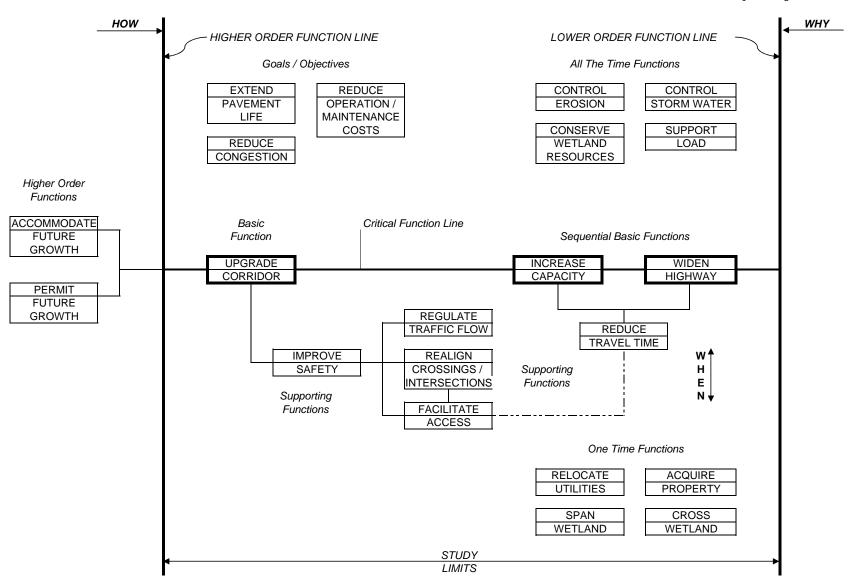
U = Unwanted N/A = Not Applicable

FUNCTION ANALYSIS SYSTEMS TECHNIQUE (F. A. S. T.)

SR 92 WIDENING; NORTHPOINT DRIVE TO CHEROKEE TRAIL Georgia Department of Transportation, District 1



Cherokee County, Georgia



CREATIVE IDEA LISTING AND JUDGMENT OF IDEAS

During the creative phase, numerous ideas, alternative proposals and/or recommendations were generated using conventional brainstorming techniques as recorded on the following pages.

These ideas were then discussed and the advantages/disadvantages of each listed. The VE design team compared each of the ideas with the concept solution determining whether it improved value, was equal in value, or lessened the value of the solution.

The ideas were then ranked on a scale of one to five on how well the VE design team believed the idea met necessary criteria and program needs. The higher rated ideas were then developed into formal alternatives and included in the VE workshop. Some ideas were judged to have minimal cost impacts on the project but provided enhancements in the form of improved operations, efficiency, constructibility or potential to save unknown or hidden costs. These were given the designation "DS" which indicates a design suggestion. This designation is also used when an idea is difficult to price but improves the functionality of the project or system, and is deemed to be of significant value to the owner, user, operator, or designer.

Typically, all ideas rated four or above are included in the Study Report. When this is not the case, an idea was combined with another related idea or discarded, as a result of additional research that indicated the concept was not cost-effective or technically feasible.

The reader is encouraged to review the *Creative Idea Listing and Evaluation* worksheets since they may suggest additional ideas that can be applied to the design.



SHEET NO.: 1 of 4

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

NO.	IDEA DESCRIPTION	RATING
	ALIGNMENT FOR PROJECT 40 (A-x (40))	
A-1 (40)	Shift alignment to use existing pavement where possible – asymmetrical expansion	4
A-2 (40)	Cul-de-sac Wabash Trail at SR 92	3
A-3 (40)	Realign Tyson Drive with Wade Green Road	2
A-4 (40)	Cul-de-sac Dates Lane at SR 92	2
A-5 (40)	Eliminate median break at Quail Run	4
A-6 (40)	Retain existing alignment between STA 95+450 to STA 960+300 (Combine with Alternative A-8 (40))	4
A-7 (40)	Signalize Dixie Drive intersection	4
A-8 (40)	Eliminate median break at STA 95+875 (combine with Alternative A-6 (40))	4
A-9 (40)	Cul-de-sac Bascomb Carmel Road at SR 92	2
A-10 (40)	Connect Love Joy Lane with Cherokee Trail	3
	ROADWAY FOR PROJECT 40 (R-x (40))	
R-1 (40)	Use twenty foot medians	4
R-2 (40)	Use concrete barriers in lieu of medians	4
R-3 (40)	Eliminate curb and gutters and use ditches	3
R-4 (40)	Eliminate sidewalks	4
R-5 (40)	Do not obliterate pavement	4
R-6 (40)	Reduce pavement section	2
R-7 (40)	Use alternate material for sidewalk	4
R-8 (40)	Reduce width of shoulders	4
R-9 (40)	Use a reversible, signalized lane	2
R-10 (40)	Use a five-lane road extension	4
R-11 (40)	Balance cut and fill	2
R-12 (40)	Eliminate retaining walls and use graded slopes (combine with Alternative R-15 (40))	2
R-13 (40)	Reduce height of retaining walls – use handrails	4
R-14 (40)	Use mechanically stabilized earth (MSE) walls in lieu of cast-in-place (CIP) retaining walls	3
R-14 (40)	Use mechanically stabilized earth (MSE) walls in lieu of cast-in-place (CIP) retaining	e Devel



SHEET NO.: 2 of 4

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

NO.	IDEA DESCRIPTION	RATING
	ROADWAY FOR PROJECT 40 (R-x (40)) (Continued)	
R-15 (40)	Use guard rails in lieu of CIP retaining walls (combine with Alternative R-12 (40))	2
R-16 (40)	Use a keystone wall in lieu of CIP retaining walls	4
	BRIDGE FOR PROJECT 42 (B-x (42))	
B-1 (42)	Span Clark Creek only with a shortened bridge – possible use existing embankment for borrow material	4
B-2 (42)	Extend existing culvert and eliminate the new bridge (Combine with Alternative A-2 (42))	4
B-3 (42)	Infill between the new structures	2
B-4 (42)	Use a single four-lane bridge	4
B-5 (42)	Tunnel under the wetlands	1
B-6 (42)	Use new culverts in lieu of new bridge	5
B-7 (42)	Use a prestressed concrete bridge	ABD
B-8 (42)	Use a steel structure for bridge	2
B-9 (42)	Use a trapezoidal bridge section and increase the spans	2
B-10 (42)	Eliminate sidewalk on bridge	4
B-11 (42)	Reduce width of bridge shoulders	4
B-12 (42)	Use a cable stayed bridge	2
B-13 (42)	Use a suspension bridge	2
B-14 (42)	Grade separate SR 92 at Woodstock Road	1
B-15 (42)	Grade separate SR 92 at Hunt Road by extending new bridge	1
B-16 (42)	Grade separate from Woodstock Road to Interstate 75	
B-17 (42)	Use AASHTO Type IV in lieu of Type BT-63 girders	4
	ALIGNMENT FOR PROJECT 42 (A-x (42))	
A-1 (42)	From existing culvert, realign SR 92 to tie at STA 87+525 (Combine with Alternatives B-2 (42), A-2 (42), and A-3 (42))	4
A-2 (42)	From existing culvert, realign SR 92 Old Alabama Road (Combine with Alternatives B-2 (42), A-1 (42), and A-3 (42))	4
Rating:	1®2 = Not to be Developed; 3®4 = Varying Degrees of Development Potential; 5 = Most likely to be ABD = Already Being Done	Developed;



SHEET NO.: 3 of 4

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

NO.	IDEA DESCRIPTION	RATING
	ALIGNMENT FOR PROJECT 42 (A-x (42)) (Continued)	
A-3 (42)	From existing culvert, realign SR 92 to STA 88+100 (Combine with Alternatives B-2 (42), A-1 (42), and A-2 (42))	4
A-4 (42)	Use a one-way pair with existing culvert and a new two-lane bridge	4
A-5 (42)	Maintain hunt Road alignment	4
A-6 (42)	Cul-de-sac Old Alabama Road at STA 87+525	3
A-7 (42)	Delete Plantation Road extension	3
A-8 (42)	Realign mulch truck traffic to Little Ridge Road extension – eliminate James Dupree Lane	5
A-9 (42)	Realign between STA 88+200 to STA 89+100	2
A-10 (42)	Shift alignment to use existing pavement where feasible – asymmetrical expansion	4
A-11 (42)	Reconfigure Woodstock Road intersection	3
A-12 (42)	Terminate Settlement Road at SR 92	3
A-13 (42)	Terminate South Sycamore Road at SR 92	3
A-14 (42)	Realign from beginning of project to Plantation Road – STA 18+000 of existing alignment	4
	ROADWAY FOR PROJECT (42) (R-x (42))	
R-1 (42)	Use twenty foot medians	4
R-2 (42)	Use concrete barriers in lieu of medians	4
R-3 (42)	Widen to Woodstock Road only	3
R-4 (42)	Widen six lanes to Woodstock Road and only four lanes from Woodstock Road west	3
R-5 (42)	Eliminate curb and gutters and use ditches	3
R-6 (42)	Eliminate sidewalks	4
R-7 (42)	Do not obliterate pavement – just abandon	4
R-8 (42)	Reduce pavement section	2
R-9 (42)	Use alternate material for sidewalk	4
R-10 (42)	Reduce width of shoulders	4
R-11 (42)	Use a reversible, signalized lane	2

Rating: $1 \otimes 2 = \text{Not to be Developed};$ DS = Design Suggestion;

 $\label{eq:continuous} 3@4 = \mbox{Varying Degrees of Development Potential}; \\ \mbox{ABD} = \mbox{Already Being Done}$



SHEET NO.: 4 of 4

PROJECT: SR 92 WIDENING

NORTHPOINT DRIVE TO CHEROKEE TRAIL

Final Design Development

NO.	IDEA DESCRIPTION	RATING
	ROADWAY FOR PROJECT (42) (R-x (42)) (Continued)	
R-12 (42)	Use a five-lane road extension	4
R-13 (42)	Balance cut and fill	3